THE

REPERTORY

Serfojee Rajah. 1827

OF

ARTS AND MANUFACTURES:

CONSISTING OF

ORIGINAL COMMUNICATIONS,

SPECIFICATIONS OF PATENT INVENTIONS,

AND

SELECTIONS OF USEFUL PRACTICAL PAPERS

FROM THE

TRANSACTIONS

OF THE

PHILOSOPHICAL SOCIETIES

OF ALL NATIONS, &c. &c.

VOL. I.

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CONTENTS

OF THE

FIRST VOLUME.

Page

I. Specification of Mr. TILSTONE's Patent for his new-invented Article in the making of Hats, — 1

II. Specification of Mr. ASHTON's Patent for his new Method of Tanning, — — 4

III. Specification of Mr. WATT's Patent for his Method of copying Writings, — — 13

IV. Specification of Mr. GREEN's Patent for Warming Rooms, &c. with Air more pure than uſual, 21

V. Obſervations on pruning Orchards; by THOMAS SKIP DYOT BUCKNALL, Eſq. — 25

VI. Deſcription of a Preſervative Wheel for a Wheel Crane; by Mr. DIXON, - - 34

VII. Deſcription of an Improvement in the common Spinning Wheel; by Mr. ANTIS, — 37

VIII. Deſcription of the Chineſe Method of making large Sheets of Paper; by Dr. FRANKLIN, 41

IX. Deſcription of a Spring-block, to aſſiſt a Veſſel in ſailing; by FRANCIS HOPKINSON, Eſq. — 44

Page

X. Defcription of a Machine for meafuring a Ship's Way; by the fame, — — 49

XI. Account of the Method of bleaching Cloths and Thread, by the oxygenated muriatic Acid; by M. BERTHOLLET, — — — 53

XII. On the Means of making Inftruments of Elaftic Gum; by Mr. GROSSART, — 70

XIII. Specification of Mr. BELLAMY's Patent for making Leather, &c. Water-proof, — 73

XIV. Specification of Meff. ROWLAND and PICKERING's Patent for conftructing navigable Canals without Locks, — — — 81

XV. Specification of Mr. KING's Patent for his new-invented Britifh Barilla, — — 89

XVI. Defcription of a Machine for twitching Wool; by Mr. HUGHES, — — 93

XVII. Method of curing the Diforder of Sheep, called the Scab; by Sir JOSEPH BANKS, Bart. 97

XVIII. Account of fome Experiments on Wheel Carriages; by RICH. LOVELL EDGEWORTH, Efq. 101

XIX. Obfervations on the Magnetic Fluid; by Capt. OBRIEN DRURY, — — 111

XX. Improvement on Metallic Conductors, or Lightning-Rods; by Mr. PATTERSON, — 114

XXI. Method of diffipating the noxious Vapour found in Wells, &c. by Mr. ROBINSON, — 119

XXII. Continuation of M. BERTHOLLET's Method of bleaching Cloths and Thread, — 121

XXIII. Conclufion of Mr. GROSSART's Method of making Inftruments of elaftic Gum, — 131

XXIV. Specification of the Earl of DUNDONALD's Patent for extracting Tar, &c. from Pit-Coal, 145

XXV. Specification of Mr. BELL's Patent for his new-invented Buckles, — — 149

XXVI.

Page

XXVI. Specification of Mr. STREET's Patent for his Invention to produce an inflammable Vapour Force, — — — 154

XXVII. Specification of Mr. CAMPBELL's Patent for his Method of destroying Colour in Rags, &c. 156

XXVIII. An Idea of a simple Instrument for measuring Distances; by JAMES PEACOCK, Esq. — 163

XXIX. On an universal Standard of Measure; by Mr. ROBERT LESLIE, — — 170

XXX. Account of the Method of making Stilton Cheese; by Mr. JOHN MONK, — — 175

XXXI. On preserving Sea-Water from Putrefaction; by Mr. THOMAS HENRY, — — 178

XXXII. Continuation of M. BERTHOLLET's Method of bleaching Cloths and Thread, — 190

XXXIII. On the Manner of rendering Leather impermeable to Water; by the Chevalier de St. REAL, — — 202

XXXIV. Specification of Mr. WATT's Patent for lessening the Consumption of Steam and Fuel in Fire-Engines, — — 217

XXXV. Specification of Mr. GOWER's Patent for depurating and improving Animal Oil, — 221

XXXVI. Specification of Mr. BAYLEY's Patent for a Machine for dying Handkerchiefs, &c. 225

XXXVII. Description of a Patent Machine for combing Wool; by the Rev. E. CARTWRIGHT, 228

XXXVIII. Observations on making Butter, and on keeping Milch-Cows in the House; by Mr. ROBERTSON, — — 234

XXXIX. Description of a proportional Scale; by Mr. BAYLEY, — — 244

XL. Description of a Nail and Bolt-drawer; by Mr. RICH, — — — 246

XLI. A Treatise on Saltpetre, by JAMES MASSEY, Esq. 248

XLII.

Page

XLII. Conclufion of M. BERTHOLLET's Method of Bleaching Cloths and Thread, — 260

XLIII. Continuation of the Chevalier de St. REAL's Memoir on rendering Leather impermeable to Water, — — 274

XLIV. Specification of Mr. STRATTON's Patent for his improved Kitchen-range, &c. — 289

XLV. Specification of Mr. FULLARTON's Patent for feparating Iron from Iron-ftones, &c. and reducing it into malleable Iron, — 297

XLVI. Specification of Mr. HOYLE's Patent for communicating Heat to all Kinds of Buildings, 300

XLVII. Specification of Mr. MENISH's Patent for making Sal ammoniac and other Salts, — — 303

XLVIII. Obfervations on keeping Milch-cows in the Houfe; by Meffrs. RENNIE, BROUN, and SHIRREFF, — — 306

XLIX. Method of preventing Stone Retorts from breaking, &c. by Mr. WILLIS, — 310

L. Defcription of three Inftruments for drawing in Perfpective; by JAMES PEACOCK, Efq. — 313

LI. Continuation of Mr. MASSEY's Treatife on Saltpetre, — — — 321

LII. Continuation of the Chevalier de St. REAL's Memoir on rendering Leather impermeable to Water, 341

LIII. Obfervations on oxygenated muriatic Acid; by M. CHAPTAL. — — 355

LXIV. Specification of Mr. BRAMAH's Patent for a Water-Cock upon a new Conftruction, — 361

LV. Specification of Mr. WILKINSON's Patent for his Method of making Caft Iron, &c. — 370

LVI. Specification of Mr. Ward's Patent for his Method of changing Smoke or Vapour into ufeful Materials — — — 373

LVII.

Page

LVII. Letter from WILLIAM PITT, Esq. on saving Part of the Water, commonly expended in Canal Lockage, — — 376

LVIII. Description of a Telegraph; by T. N. Esq. 382

LIX. Description of a Tide Wheel; by Mr. ROBERT LESLIE, — — 385

LX. Account of the Method of curing Butter at Udny, &c. by Dr. ANDERSON, — — 389

LXI. Conclusion of Mr. MASSEY's Treatise on Salt petre, 392

LXII. Conclusion of the Chevalier de St. REAL's Memoir on rendering Leather impermeable to Water, 409

LXIII. Conclusion of M. CHAPTAL's Observations on oxygenated muriatic Acid, — 427

PLATES

PLATES

IN THE

FIRST VOLUME.

	Page
1. Presses used in copying Writings, —	20
2. Preservative Wheel for Cranes, — —	36
3. Improved Spinning-Wheel, — —	40
4. Spring-Block,. — — —	48
5 and 6. Furnaces used in making British Barilla,	92
7. Machine for twitching Wool, — —	96
8. Apparatus for experiments on Wheel carriages,	112
9, 10, 11. New-invented Buckles, — —	152
12. Machine for inflammable vapour force, —	155
13. Instrument for measuring Distances, —	168
14. Machine for combing Wool, — —	232
15. Proportional Scale, and Nail and Bolt Drawer,	246
16 and 17. Apparatus for oxygenated muriatic Acid,	272
18 and 19. Improved Kitchen-range, —	296
20 and 21. Instruments for drawing in Perspective,	320
22. New-constructed Water-Cock, —	368
23. Furnace for making Cast Iron, — —	372
24. Manner of saving Water in Canal Lockage,	380
25. Tide Wheel, — — —	388

ADVERTISEMENT.

OF the work now offered to the public, one of the principal objects is, to establish a vehicle, by means of which new discoveries and improvements, in any of the useful Arts and Manufactures, may be transmitted to the public; particularly to Artists, Manufacturers, and others, who, from various circumstances frequently attending those discoveries and improvements, (such as their being announced in a bulky or expensive publication, or in a foreign language,) might otherwise have but little chance of ever becoming acquainted with them. Yet, though novelty will be regarded as an important consideration, the general utility of a subject will always be looked upon as one of equal, if not of greater, consequence. On this account, the editors mean never to reject or withhold any useful information, although it

it may not be entirely new; provided they have reaſon to ſuppoſe, that it is not generally known to that claſs of perſons for whom, as was obſerved before, their labours are particularly intended.

Specifications of patents will, it is preſumed, be found an intereſting part of this work. In ſelecting theſe the editors may probably ſometimes appear to be guided by neither of the above-mentioned conſiderations; there being with reſpect to patents another, which in their opinion it would be wrong to overlook; namely, the gratification of public curioſity. Conſequently, whenever they have reaſon to think they can gratify that curioſity, by the inſertion of any particular ſpecification, they will conſider it as their duty to inſert it, though the invention for which the patent is granted ſhould not appear to *them* to poſſeſs any great claims to public notice. It may not be improper to obſerve, that the ſpecifications are given exactly in the words of the original, as recorded in the patent-office. The preambles and concluſions are omitted in all except the firſt;

firſt; in that they are retained, to ſhew their general form.

The Tranſactions of learned Academies and Societies form another great ſource from which the editors will derive their materials. As ſome of theſe ſocieties are inſtituted with views, in many reſpects, ſimilar to their own, their tranſactions will, of courſe, furniſh a greater portion of matter than thoſe of others. All of them, however, contain much ſpeculative or other matter, foreign from the purpoſe of this publication; a ſelection therefore of the more uſeful practical papers (in which particular attention will be paid to thoſe which have obtained premiums, or any other mark of diſtinction,) will not, it is hoped, be unacceptable or unintereſting to the public. It is, at leaſt, fair to conclude, that whatever thoſe academies or ſocieties have determined to be worthy of publication muſt be, in ſome degree, deſerving the attention of thoſe who are any ways intereſted in the ſubjects treated of.

In the Tranſlations of thoſe parts which are ſelected from the Tranſactions of Foreign Acade-

Academies, or from any other publications in foreign languages, ſuch terms will, as much as poſſible, be made uſe of as are ſuppoſed to be moſt familiar to artiſts and manufacturers in general; this the editors think better than to adopt thoſe new ones, which (however uſeful and neceſſary they may be in many inſtances) too often owe their origin, not to any deſire to advance the more uſeful parts of ſcience, but to a ſpirit of innovation, or a wiſh to appear profound rather than to be intelligible.

Beſides the ſources already mentioned, the editors truſt they ſhall find another, no leſs valuable, in the communications of thoſe who cultivate the uſeful arts, whether they do ſo for profit or pleaſure; theſe will be conſidered as very acceptable, and every proper reſpect will be paid to them.

They may be addreſſed to the Editors, at the Repertory-Office, No. 182, Fleet-ſtreet.

REPERTORY OF ARTS AND MANUFACTURES.

NUMBER I.

I. Specification of the Patent granted to Mr. JOSEPH TILSTONE, for his new-invented material Article in the making of Hats.

TO all to whom these presents ſhall come, I Joſeph Tilſtone, of Newcaſtle, in the county of Stafford, hat-manufacturer, do ſend, greeting. Whereas his moſt excellent Majeſty, King George the Third, by his letters patent, under the great ſeal of Great Britain, bearing date at Weſtminſter the ſixteenth day of January, in the thirty-fourth year of his reign, did give and grant unto me the ſaid Joſeph Tilſtone, my executors, adminiſtra-

tors and aſſigns, his ſpecial licence, that I the ſaid Joſeph Tilſtone, my executors, adminiſtrators, and aſſigns, during the term of years therein expreſſed, ſhould, and lawfully might, make, uſe, exerciſe, and vend, within England, Wales, and the town of Berwick upon Tweed, my new-invented material article in the making of hats; in which letters patent there is contained a proviſo, obliging me the ſaid Joſeph Tilſtone, under my hand and ſeal, to cauſe a particular deſcription of the nature of my ſaid invention, and in what manner the ſame is to be performed, to be inrolled in his Majeſty's High Court of Chancery, within one calendar month next and immediately after the date of the ſaid recited letters patent, as in and by the ſame (relation being thereunto had) may more fully and at large appear: Now KNOW YE that, in compliance with the ſaid proviſo, I the ſaid Joſeph Tilſtone do hereby declare, that my ſaid invention is the hair of or from kid's ſkin, or kid-hair; which, if taken off the ſkin with lime, muſt be waſhed in water, or beat, to free it from the lime; but if taken off the ſkin by ſtoving, or without lime, then

then the waſhing or beating will be unneceſſary. After the ſame is dried in the air, or upon the kiln, the hair may be mixed with wool, and made into hats, or made into hats without the aid of any other article; the ſame proceſs of manufacture being purſued as is uſual in the manufacturing of hats commonly called felt hats. In witneſs whereof I the ſaid Joſeph Tilſtone have hereunto ſet my hand and ſeal, the ſixth day of February, in the year of our Lord one thouſand ſeven hundred and ninety-four.

Signed,

JOSEPH TILSTONE. (L. S.)

tors and aſſigns, his ſpecial licence, that I the ſaid Joſeph Tilſtone, my executors, adminiſtrators, and aſſigns, during the term of years therein expreſſed, ſhould, and lawfully might, make, uſe, exerciſe, and vend, within England, Wales, and the town of Berwick upon Tweed, my new-invented material article in the making of hats; in which letters patent there is contained a proviſo, obliging me the ſaid Joſeph Tilſtone, under my hand and ſeal, to cauſe a particular deſcription of the nature of my ſaid invention, and in what manner the ſame is to be performed, to be inrolled in his Majeſty's High Court of Chancery, within one calendar month next and immediately after the date of the ſaid recited letters patent, as in and by the ſame (relation being thereunto had) may more fully and at large appear: Now KNOW YE that, in compliance with the ſaid proviſo, I the ſaid Joſeph Tilſtone do hereby declare, that my ſaid invention is the hair of or from kid's ſkin, or kid-hair; which, if taken off the ſkin with lime, muſt be waſhed in water, or beat, to free it from the lime; but if taken off the ſkin by ſtoving, or without lime,

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Signed,

JOSEPH TILSTONE. (L. S.)

II. Specification of the Patent granted to Mr. SAMUEL ASHTON, of Sheffield, Yorkſhire, for his new Method of Tanning.

Dated Jan. 16, 1794.

TO all to whom theſe preſents ſhall come, &c. &c. NOW KNOW YE that, in compliance with the ſaid proviſo, I the ſaid Samuel Aſhton do hereby declare, that my ſaid invention of a method of tanning hides and ſkins is deſcribed in manner following; that is to ſay, by the method of tanning which I have invented, hides and ſkins are completely tanned into leather of an excellent quality, without the aſſiſtance of bark, in much leſs time, and at conſiderable leſs expence, than by any other method hitherto known or practiſed. The following is a general deſcription of the materials to be uſed as ingredients, in preparing the tan-liquor made uſe of in my proceſs of tanning, hereinafter deſcribed; that is to

to ſay, iron, either in its metallic or calciform ſtate, or diſſolved or mineralized with ſulphur, or mixed with ſulphur and clay, ſulphurated arſenic, vitriolic acid, or phlogiſton, or with any other ſulphurated or arſenical metal or metals. Copper, either in its metallic or calciform ſtate, or diſſolved or mineralized with ſulphur, ſulphurated iron, or ſulphur iron and arſenic, or diſſolved by vitriolic acid, or with phlogiſton, or mixed with any other ſulphurated or arſenical metal or metals. Zinc in its metallic ſtate, or calciform, mixed with martial ochre, or mineralized with ſulphurated iron, or by ſulphur arſenic and iron, or by vitriolic acid, mineral phlogiſton, or bitumen united with vitriolic acid, or ſaturated with iron, or combined with iron, iron and copper, iron and zinc, iron and arſenic, or copper, and generally all metal, metallic, or metalline ſubſtances, foſſils, ores, calces, earths, ſands, clays, and ſtones, whoſe aſtringent baſes are ſaturated with, or principally compoſed of, all or any of the above deſcribed ſubſtances or matters, or that are therewith impregnated or combined in ſuch degree or proportion as not to be

neu-

neutralized, or that are properly denominated aſtringent, ſulphureous, ſulphurated, vitriolic, vitriolated, arſenical, martial, ferruginous, or cupreous, and all mineral waters impregnated, in a ſufficient degree, with all or any of the above deſcribed ſubſtances or matters. And all preparations made of or from the ſaid deſcribed ſubſtances or matters, in mineral waters, wherein their reſpective aſtringent, ſuphureous, ſulphurated, vitriolic, vitriolated, arſenical, martial, ferruginous, or cupreous virtues, qualities, or particles, are preſerved, and not deſtroyed, or neutralized. The following materials are particularized from the above, in order to elucidate the proceſs and proper method of preparing the ſaid tan-liquor; namely, iron, native iron, the ruſt of iron, *minera ochracea* or martial ochre, *ochra ferri*, bog ore, blood-ſtone or hæmatites, *ferrum ſulphure ſaturatum* or marcaſite, black iron ore or iron ſtone, the pyrite ſulphureous ſtone, the arſenical pyrites, martial coal ore. Copper, native copper, *ochra veneris*, grey or vitreous copper ore, yellow or marcaſitical copper ore, white copper ore, vitriol of copper, copper coal ore. Zinc, native

native zinc, calamine, zinc ore, blende, vitriol of zinc. Sulphur or brimſtone, native ſulphur, pale yellow pyrites, liver-coloured marcaſite, the ſulphureous coal, the bovey coal, alum, ſlate, and peat. The following preparations and proportions illuſtrate to what degree of ſtrength or aſtringency the ſolution of the tan-liquor is to be made, and alſo which of the above particularized materials are proper to be uſed therein ſeparately, and which of them ought to be uſed together, and conſequently which of the above generally-deſcribed materials are proper to be uſed ſeparately, and which of them ought to be uſed together, in the preparation of the tan-liquor. To ſixteen pounds of ſcales or ruſt of iron, ſaturated with ſix ounces of oil of vitriol and one quart of water, mix ſix gallons of common water. To ſixteen pounds of iron ore, calcined and reduced to powder, mix ſix gallons of common water. To twelve pounds of ſulphur ſtone, or pyrite ſulphureous ſtone, calcined, mix ſix gallons of common water. To ſixteen pounds of the ferruginous yellow earth, or red ochre, calcined, mix ſix gallons of common water. To ſixteen pounds of the ſame yellow earth, in its raw ſtate,

ſtate, mix ſix gallons of water, and ſix ounces of oil of vitriol. To fourteen pounds of good copper ore, calcined and reduced to powder, mix ſix gallons of water. To ſixteen pounds of *ochra veneris*, or earth impregnated with copper, or copper ore calcined, mix ſix gallons of water. To eight pounds of ſulphur ſtone, and ſix pounds of native or calamine zinc, calcined and reduced to powder, mix ſix gallons of water. To twelve pounds of red ochre, and ſix pounds of native zinc or calamine, calcined and reduced to powder, mix ſix gallons of water. To eight pounds of ſulphur ſtone or pyrite, and four pounds of native ſulphur, calcined and reduced to powder, mix ſix gallons of water. To twelve pounds of red ochre, and four pounds of native ſulphur, calcined and reduced to powder, mix ſix gallons of water. In general, the waters iſſuing out of or from coal-pits, or the mines or places where coal, iron, or copper ores abound, when boiled for two hours, are of a ſufficient degree of aſtringency. With regard to the moſt proper and leading materials being the beſt calculated for common practice, on account of their very great abundance and cheapneſs, are the droſs of

coal-

coal-pits, called ſulphur ſtone, or pyrite ſulphureous ſtone, and the yellow ferruginous earth, or red ochre, both above deſcribed, and they will have the preference in all parts where ſuch ſubſtances abound the moſt, or to ſuch places where they are the moſt contiguous. And perhaps in Wales, and other places where the ores of copper, and other aſtringent, ſulphureous, vitriolic, or vitriolated ſubſtances, as deſcribed above, do moſt abound, theſe may claim the preference. But, of theſe matters, every perſon who follows the buſineſs of tanning will beſt judge for himſelf. It is unneceſſary to obſerve, that the above preparations and proportions are ſpecified upon the ſuppoſition that the various materials therein mentioned reſpectively contain the utmoſt degree of ſtrength or aſtringency which they in general poſſeſs; but, as the ſame are variable, according to circumſtances, with reſpect to the degree of ſtrength or aſtringency they reſpectively poſſeſs, the ſtrength of the tan-liquor muſt ultimately, in all caſes, be determined by the taſte, which ſhould be rough or auſtere; whereby, and by the aſſiſtance of the above-mentioned preparations and proportions, the proper degree of

ſtrength or aſtringency of the tan-liquor may be always known with ſufficient certainty. The proceſs of tanning the thickeſt and beſt hides, uſually termed ſole-leather, is as follows. After the operation of taking off the horns, ſcraping off the hair, paring away the looſe fleſh, and working out the fat or greaſe, is finiſhed, which may be done in the common method, the hides are to be taken to a vat, in which is prepared the tan liquor agreeably to any of the directions above ſet forth, in which they are to be laid ſmooth, and to be turned twice every twenty-four hours for the ſpace of ſeven or eight days, and once every twenty-four hours for the ſpace of five weeks; afterwards according to the number, weight, and thickneſs of the hides, at the ſame time ſtirring up the tan-liquor ſufficiently; after which they are to remain till they are ſufficiently tanned, which will in general be from five to ſeven or eight weeks, according to the quality of the tan-liquor, and the number and ſubſtance of the hides. It ſhould be obſerved, that if the tan-liquor is too ſtrong when the hides are firſt laid therein, there is a danger of its corrugating, or drawing up too cloſe, the out-

ſide

ſide parts thereof, which will prevent the operation of tanning from going on in a regular and proper ſtate, and in ſome degree injure the leather. But, in order to guard againſt this, it is proper to make the tan-liquor weaker when the hides are firſt put into the vats, and to make it ſtronger by degrees by adding thereto, every three or four days, a quantity of the materials wherewith it is prepared, for three or four weeks, ſo as in that time the whole proportion thereof may be put into the vat. In caſe it ſhould be ſuſpected that the hides are injured by too great ſtrength of the tan-liquor, it will be proper to immerſe them, for about half an hour, in a ſolution of lime or pot-aſh in water, or in any other alkaline ſolution. When the metallic ſubſtances from which the tan-liquor is prepared are calcined, it is not neceſſary to add thereto the vitriolic or ſulphuric acid, except when great expedition is required. But, when theſe ſubſtances are uſed in their raw ſtate, the vitriolic or ſulphuric acid in ſome degree anſwers the purpoſe of calcination. In thoſe caſes where the acid is uſed, it is moſt proper to omit adding it to the tan-liquor till the hides have lain therein one week.

The procefs of tanning the inferior fortment of hides, intended for crop-leather, and of calves fkins, is as follows: when the hides and fkins are prepared for the tan-vat in the ufual way, they are to be taken to a vat in which is prepared the tan-liquor, according to fome one of the directions abovementioned, and reduced to a proper ftrength and quality, by mixing therewith white clay, chalk, whiting, or other pure calcareous earth, and to be turned every fix hours for the fpace of four days, according to the number and fubftance of the hides and fkins; after which they are to remain until fufficiently tanned, which will in general be from eighteen to twenty-eight days. In the above defcribed proceffes of tanning, barks or other vegetable fubftances are not at all effential; neverthelefs, when the colour of the leather is an object to be attended to, the bark of oak, and many other barks, and feveral kinds of woods and vegetables, are ufeful, as a dye, for rendering the colour fuch as is commonly acquired by leather tanned with bark; and for this purpofe a fmall quantity of oak-bark, or logwood, put into the vat with the tan-liquor, is fufficient. After the hides

hides or ſkins are tanned, the proceſs of getting them ready for ſale is to be purſued in the common way. In witneſs whereof, &c.

III. Specification of the Patent granted to Mr. JAMES WATT of Birmingham, for his new Method of copying Letters and other Writings.

WITH A PLATE.

Dated February 4, 1780.—Term expired.

TO all to whom theſe preſents ſhall come, &c. NOW KNOW YE, that, in compliance with the ſaid proviſo, I the ſaid James Watt do hereby declare, that the nature of my ſaid invention, and the manner in which the ſame is to be performed, is particularly deſcribed and aſcertained in manner and form following; that is to ſay, let the letter or other writing that is intended to be copied be written with the ink hereinafter deſcribed, or with any other writing-ink fit for the purpoſe. Take a piece, or pieces, of thin paper which contains

tains no ſize, or glue, or gummy or mucilaginous matter, or which at leaſt does not contain ſo much ſize, or other matter, as would make it fit for being written upon. Cut this paper, or papers, to the ſize and ſhape of the writing of which a copy is wanting; moiſten or wet the ſame thin paper with water, or other liquid, by means of a ſpunge or bruſh, or by dipping, or otherwiſe. Having moiſtened or wet the thin paper, lay it between two thick unſized ſpungy papers, or between two cloths, or other ſubſtances capable of abſorbing the ſuperfluous moiſture from the thin paper; when it has been ſlightly preſſed between ſuch thick ſpungy papers, or other ſubſtances, by the hand or otherwiſe, lay the ſaid thin paper, ſo moiſtened and preſſed, upon or under the ſide of the writing which is to be copied, and in ſuch manner that the one ſide of the ſaid moiſtened paper ſhall be in contact all over the ſide of the ſaid writing, ſo intended to be copied; and that to the other ſide of the ſaid moiſtened thin paper, there ſhall be applied a piece of clean writing-paper, or cloth, or other ſmooth uniform ſubſtance. Lay the ſaid writing intended to be copied, with the thin moiſ-

tened

tened paper intended to receive the copy, (placed refpectively as above directed,) upon the board of a common rolling-prefs, or of that of which a defcription and drawing are hereunder written and drawn, and prefs them once, or oftener, through the rolls of the faid prefs, in the fame manner as is ufed in printing by copper-plates; or, inftead of ufing the faid or any rolling-prefs, fqueeze the faid papers, placed refpectively in the manner above defcribed, in a fcrew-prefs; or fubject them to any other preffure fufficient for the purpofe; by means of which preffure, in whatever manner applied, part of the ink of the writing intended to be copied fhall prefs from the faid writing into, upon, and through, the faid thin moiftened paper, fo that a copy of the faid writing, more or lefs faint, according to the quality of the ink and paper employed, fhall appear impreffed on both fides of the faid moiftened paper, viz.—Upon one of the fides in the natural or proper order and direction of the lines, as they are in the original writing, and on the other fide in the reverfe order and direction. But, in order to make the impreffion or copy of the writing more ftrong, legible,

legible, and durable, it is proper and uſeful to moiſten the ſaid thin paper, which is to receive the copy or impreſſion, with the following liquor, inſtead of water or other liquid, and to proceed in all other reſpects as is above directed; or to moiſten the ſaid thin paper with the following liquor, and to dry the ſaid paper, and, when a copy of a writing is required to be taken, the ſaid paper, thus previouſly prepared and dried, ought to be moiſtened with water or other liquid, and to be proceeded with in all other reſpects as has been directed. The ſaid liquor to be uſed for moiſtening the ſaid thin paper, or for preparing the ſaid paper previouſly to its being uſed, is made in the following manner: take of diſtilled vinegar two pounds weight, diſſolve in it one ounce of the ſedative ſalt of borax; then take four ounces of oiſter-ſhells cancined to whiteneſs and carefully freed from their brown cruſt, put them into the vinegar, ſhake the mixture frequently for four and twenty hours, then let it ſtand until it depoſits its ſediment; filter the clear part through unſized paper into a glaſs veſſel, then add to the ſaid mixture or ſolution two ounces of the beſt

blue

blue Aleppo galls bruiſed, and place the liquor in a warm place, ſhaking it frequently for twenty-four hours; then filter the liquor again through unſized paper, and add to it, after filtration, one quart, ale meaſure, of diſtilled or other pure water. It muſt then ſtand twenty-four hours, and be filtered again if it ſhews a diſpoſition to depoſite any ſediment, which it generally does. The liquor, thus compounded and prepared, is to be uſed as hath been directed.

N. B In place of the vinegar, any other liquor impregnated with a vegetable acid may be uſed; and, in place of the galls, oak bark, or any other vegetable aſtringent, or ſubſtance which is capable of becoming black, or deep coloured, with ſolutions of iron; and, in place of the oiſter-ſhells, any other pure calcareous earth may be uſed. But if the impreſſions are not wanted to be very black, and the writing ink is good, water itſelf may be uſed to moiſten the thin paper, as herein firſt directed. It may be found neceſſary to add more or leſs water, in the preparation of the above liquor to be uſed for moiſtening the thin paper, or

to vary the proportions of the other ingredients, according as they are more or leſs perfect or ſtrong, or as the impreſſion is required to be more or leſs deep coloured. The writing-ink, which I uſe for letters or writings intended to be copied, is prepared as follows: take four quarts, ale meaſure, of ſpring water; one pound and a half, avoirdupois weight, of Aleppo galls; half a pound of green copperas or green vitriol; half a pound of gum-arabic; four ounces of roach-alum; pound the ſolid ingredients, and infuſe them in the water ſix weeks or two months, during which time the liquor ſhould be frequently ſhaken; ſtrain the liquor through a linen cloth, and keep it in bottles, cloſely corked, for uſe. In witneſs whereof, &c.

Deſcription of the Rolling-Preſs, &c.
See Plate I.

Fig. 1. Repreſents a front or end view of the rolling-preſs invented by me, and referred to in the above ſpecification. ABC. is one of the ends of an iron or wooden frame, which ſerves to connect the two rollers. DD. are two wooden or metalline rollers, turned extremely exact, or truly cylin-

cylindrical, and which are mounted on iron axles, firmly fixed in them. E E. is a double-ended lever, by means of which the roller, on whofe axle it is applied, may be forcibly turned round. F F. reprefents the board of the rolling-prefs, on which the writings to be copied are to be laid. N N. is a piece of cloth, or other elaftic pliable fubftance, placed next the roller, and above the writings to be copied; and the board G. is a ftrong plank of wood, or plate of metal, ferving to connect the two end-pieces of the frame at bottom. H H. reprefents the edge of a common table, to which the prefs may be faftened by the iron fcrew-camps I I. K. is a flit, of which there is one in each end-piece of the frame; thefe flits are filled with elaftic fteel, or other metalline fprings, or with fome other elaftic fubftances which ferve to prefs the two rollers forcibly together. L. is a brafs bolfter, fupported upon the fprings, and ferving to fupport the end of the axis of the under roller.

Fig. 2. Reprefents a fide view of the rolling-prefs, in which A B. A B. are the two end-pieces of the frame. D D. are the two rollers. E. is

 the

the double-ended lever. G. is the ſtrong plank, or plate of metal, which forms the bottom of the frame. H H. is the table on which the preſs ſtands. I. is one of the iron cramps which faſten the preſs to the table; and M. is a bar of iron which connects the upper part of the frame.

Fig. 3. Repreſents a ſcrew-preſs, which may be uſed, inſtead of the rolling-preſs, in taking off impreſſions from writings. AA. is a double-ended lever. B B. the ſcrew. C. a block of wood, or metal, which the ſcrew acts upon, and which is attached to it. D D. the frame of the preſs, made of iron or wood. E E. is a movable board, on which the writing to be copied is to be laid, with a cloth over it. F F. the bottom or ſole of the preſs, made of wood or metal. Be it remembered, that theſe preſſes are made of different ſizes, according to the ſizes or largeneſſes of the writings intended to be copied. Thoſe drawn above are drawn from one ſufficiently large to take an impreſſion from a folio page of writing or poſt paper, and are drawn to a ſcale of one inch and a half for each foot, or one eighth of their natural ſize.

IV.

Fig. 1.

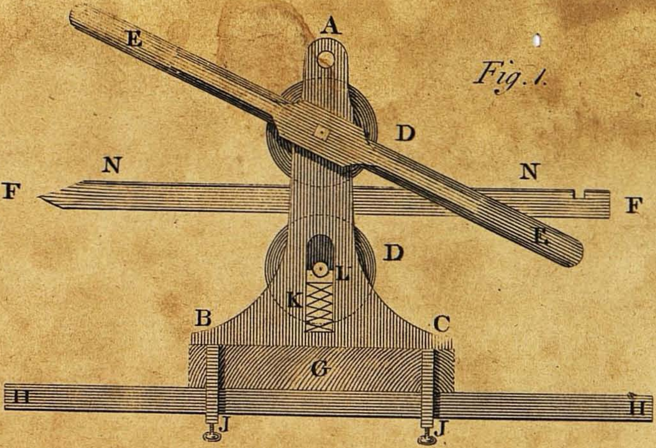


Fig. 2.

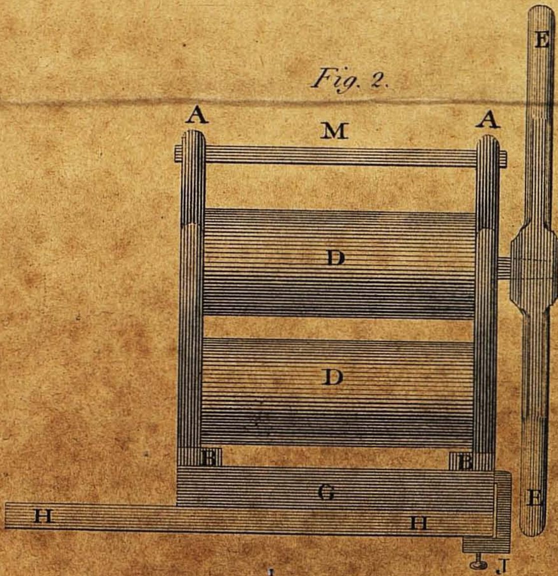
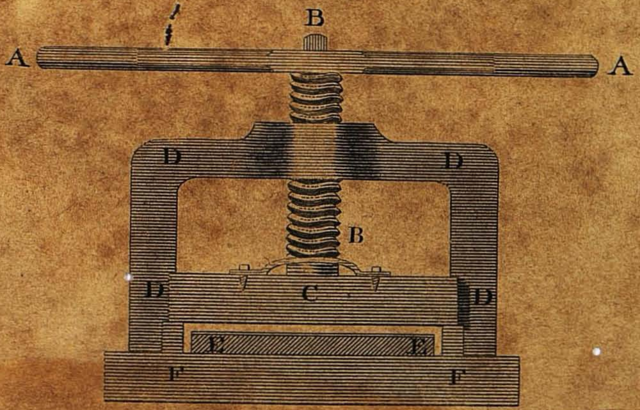


Fig. 3.



IV. Specification of the Patent granted to JOSEPH GREEN, of Weſthill, in the Pariſh of Wandſworth, Surrey, Gentleman; for his Invention and Method of warming Rooms, and Buildings, with hot Air of a more pure Quality than has hitherto been uſed.

Dated Dec. 9, 1793.

TO all to whom theſe preſents ſhall come, &c. Now KNOW YE, that I the ſaid Joſeph Green, in purſuance of, and in compliance with, the ſaid proviſo in the ſaid letters patent, do hereby deſcribe and aſcertain the nature of the ſaid invention, and in what manner the ſame is to be performed, as follows; that is to ſay, the principle on which my invention is founded is the heating air, for the purpoſe of warming buildings, by means of hollow veſſels, or pipes, immerſed in hot

hot water or ſteam, whereby too great a degree of heat is avoided, and the air remains unburnt, and fit for reſpiration; and I provide a boiler made of iron, copper, or other fit materials, with a cover faſtened thereto. Within the boiler I fix a hollow veſſel or worm, and ſometimes ſeveral ſuch veſſels or worms, made of lead, copper, earthen ware, or other proper materials; and into each of theſe hollow veſſels or worms I introduce the external or open air, by the medium of a pipe, which I make to paſs through a convenient part of the boiler, firmly ſoldered or cemented into it; and which pipe I communicate with the ſaid veſſels or worms. The boiler may be fixed in the ordinary manner in any of the lower apartments, or other convenient part of the houſe or buildings; or it may be fixed behind a ſtove or grate, ſo as to be heated by means of a common fire, in any of the rooms, and the ſize of it ſhould be regulated by the extent of the building propoſed to be warmed. From the hollow veſſels or worms abovementioned, pipes of any of the abovementioned materials are fixed and carried, in the moſt convenient manner, to the different rooms, or parts of the

the buildings, to which the warm air is to be conveyed. To theſe pipes are fixed cocks or ſliders, in order to admit, or prevent, the introduction of the warm air into any particular room or place; and in ſome convenient part of the pipes I place a ſnifting valve, or ſelf-acting cock, to prevent the burſting of the boiler, or pipes, by the force of the ſteam. The boiler being in part filled with water, a fire is lighted in the furnace, and the water made to boil, or brought to ſuch a degree of heat as may be found neceſſary; by this heat the air contained in the hollow veſſels or worms before-mentioned, being rarefied and warmed, will aſcend, and is to be admitted, by means of the above-mentioned cocks or ſliders, or by any other convenient mode, into the ſeveral apartments to be warmed. When the rooms are at too great a diſtance from the boiler to be warmed by ſingle pipes, then, in order to prolong the direction of the heat, I either incloſe the pipes, through which the warm air is conveyed, in large pipes, to which the ſteam riſes from the boiler, or I introduce the warm air into the larger, and the ſteam into the ſmaller pipes; by which means the air-pipes are

prevented

prevented from growing cool ſo ſoon as they would do if they were expoſed to the action of the open air. I alſo in certain caſes, where I judge it proper and more convenient, place my air-veſſel or worm in a veſſel diſtinct from the boiler, but ſtill having a communication therewith for the ſteam from the boiler to paſs, and thus heat the air-veſſel or worm by means of ſteam only; by the above proceſs too great a degree of heat is avoided, and the air remains unburnt, and fit for reſpiration. In witneſs whereof, &c.

V. Obſervations relative to the Pruning of Orchards, by THOMAS SKIP DYOT BUCKNALL, Eſq. of Conduit-ſtreet.

From the TRANSACTIONS of the SOCIETY for the Encouragement of ARTS, MANUFACTURES, and COMMERCE.

The Silver Medal of the Society was voted to Mr. BUCKNALL, for theſe Obſervations.

THE bark of trees, properly conſidered, conſiſts of three diviſions; the outer, rough; the middle, ſoft and ſpongy; the inner, a whitiſh rind, being that which joins the bark to the wood; and this laſt is ſuppoſed to contain the liquid ſap. It is conſtantly obſerved, that when the ſtem of the tree grows too faſt for the bark, it cauſes blotches and lacerations; which evil is properly avoided by ſcoring the bark with a ſharp knife: but care ſhould be taken not to cut through the

whitiſh rind before-mentioned; for that heals very difficultly, generally ulcerates, and, by being cut through, gives the inſects * an opportunity of getting between the wood and the bark, where they are very deſtructive.

Any ſurgeon knows that a wound extending to the fine membrane, covering the bones of the human body, requires much more ſkill to cure than a fleſh wound, and the caſe is ſimilar.

Pruning is an important article with regard to the health of trees, and their bearing; and, if judiciouſly done, they will come into bearing ſooner, and continue in vigour for nearly double their common age: but the ſyſtems of pruning are ſo wordy, that the common farmer cannot underſtand them; and the gardener thinks the orchard beneath his care, for which reaſon it is left to nature and the winds; for, the farmer, afraid of doing

* Inſects, ſuch as ants, earwigs, and many ſpecies of millepedes, with numerous microſcopic creatures, of which I know no name; but all of which obſtruct the healing of the wounds, by their conſtant eating and fretting the tender bark.

wrong,

wrong, never troubles himſelf about it, unleſs, ſeeing a branch half-broken, he takes his bill, and knocks it off, perhaps four or five inches from the trunk, leaving an unſightly ſtump. Do not imagine this is intended as any reproach; for there are no men who ſpend their time more judiciouſly in their vocation, but they cannot run into ſpeculations; if they did, little rent would be paid. I give no attention to fruit-branches and wood-branches, as being unneceſſary in the preſent inſtance; and beg, once for all, that no branch ſhall ever be ſhortened, unleſs for the figure of the tree, and then conſtantly taken off cloſe at the ſeparation; by which means the wound ſoon heals. The more the range of the branches ſhoots circularly, a little inclining upwards, the more equally will the ſap be diſtributed, and the better will the tree bear; for, from that circumſtance, the ſap is more evenly impelled to every part. Do not let the ranges of branches be too near each other; for remember, all the fruit and the leaves ſhould have their full ſhare of the ſun; and, where it ſuits, let the middle of the tree be free from wood, ſo that no branch ſhall ever croſs another, but all the extreme ends point outwards.

The beſt compliment your neighbour can make is, that your trees are handſome, but too thin of wood: be it ſo; and you may ſay, "True, farmer; but I have the beſt price at market, and that will always be the ſure teſt of perfection.

My tenant, Mr. Boulding, planted an orchard in 1772: being on a rich ſoil, it throve ſurpriſingly. That vigorous growth occaſioned the after decay of the trees; for, the wind, having great power over them, ſplit them down; the ladders, in gathering, broke them; the wood being ſoft, many cauſes concurred to injure them; and the injudicious manner in which the lacerations were taken off added to the evil; for, there generally follows gum from a wound, which being ſweet in fruit-bearing trees, the wound becomes filled with vermin, which obſtruct the healing by their conſtantly eating and fretting the young bark.

Being informed of the ſituation the orchard was in, I went down in the ſpring of 1790, and found the branches ſo intermixed and entangled together, that in many places they had cut each other nearly half

half through, cauſing wounds and blotches; which, on the return of the ſap in the ſpring, always affect the leaves, by inclining them to curl, and is a proof that the ſap is vitiated.

Having examined the circumſtances, I told the tenant I would come down in the autumn, when proper perſons muſt be found to execute the buſineſs, and we would reinſtate the orchard, and bring it to its former ſplendor; for, it ſhould be obſerved, the orchard uſed to be much admired. Accordingly, I went the firſt Tueſday in November, and for two hours walked over the ground with the men, inſtructing them what I would have done, that we might begin the next morning, work with ſpirit, and loſe no time. We had ſaws, bills, and knives, prepared on purpoſe; and, though I am a good hand myſelf, I ſoon perceived neither of us could cut true enough with a bill to take off the branch, without leaving a ſtump, or improper wound; for it is eſſentially neceſſary, that every branch ſhould be cut perfectly ſmooth and cloſe; for which reaſon we took the ſaws, and afterwards ſmoothed the place with a knife.

My

My ſervant's buſineſs was, with a painter's bruſh, to ſmear over the wounds with a medicated tar hereafter deſcribed.

It is impoſſible the bark can grow over a ſtump, becauſe there is no power to draw the ſap that way; for which reaſon always cut a little within the wood. I was conſtantly directing to cut quick, cloſe, and ſmooth. We kept together, firſt walked round the tree; then I pointed out every branch that came near to the ground, or had received any material injury, or where the leaves were much curled; for, where the leaves curl, the fruit is always ſpecky; and every branch which had the leaſt tendency to croſs the tree, or run inwards, was taken off. Then we gave a little attention to the beauty of the head, leaving all the branches as nearly equidiſtant as poſſible: next, we examined if there were any remaining blotches, opening or ſcoring them with a knife, and, where the back was ragged from any laceration, paring it gently down till we came to the live wood. Each of theſe was touched over with the medicated tar.

Having

Having gone thus far, we ſhould have rubbed off the moſs, and ſcored the trees, but I had not time for that part of the buſineſs; I only wiſh I had ſecured a perſon on purpoſe. In the cutting we followed the ſurgeon's rule; go to the quick, but do not wantonly make any wound larger than neceſſary.

We ſometimes had our doubts whether a particular branch ſhould be taken off. The idea I brought it under was this; conſider whether it will be in the way three years hence; if it will, the ſooner it is off the better.

When trees are much thinned, they are ſubject to throw out a great quantity of young ſhoots in the ſpring, which I requeſted the tenants to be particularly careful to rub off. It is neceſſary that they be rubbed, and not cut; for cutting increaſes the number.

As our work drew near a concluſion, one of the tenants ſaid, "we underſtand our buſineſs ſo well, that I wiſh we had another job;" upon which my

ſervant,

ſervant obſerved, "you had better keep in your own pariſh, for the people are much diſſatisfied." The truth is, we had no comforters, for the country was againſt us. If the land had been under my own culture, I ſhould have taken off half as much more; but I did not chooſe to offend the perſon whom I wiſhed to inſtruct.

I went down again, in the ſpring of 1791, to ſee the effect, and found the tenants much pleaſed with the operation; I did not find one wound in an hundred but what was in a clear healing ſtate, and the healing of the wounds is the buſineſs; for nothing but prejudice can make a perſon think that a tree overloaded with wood will produce good fruit. You may as well expect a crop of turneps without hoeing, and I am in great hopes that pruning will become as general as hoeing; I am ſure it is as neceſſary.

The medicated tar above mentioned, as uſed in the foregoing experiments, was compoſed of one quarter of an ounce of corroſive ſublimate, reduced to fine powder, by beating with a wooden hammer,

hammer, and then put into a three-pint earthen pipkin, with about a glaſs full of gin, or other ſpirit, ſtirred well together, and the ſublimate thus diſſolved. The pipkin was then filled, by degrees, with vegetable or common tar, and conſtantly ſtirred, till the mixture was blended together as intimately as poſſible; and this quantity will, at any time, be ſufficient for two hundred trees.

To prevent danger, let the corroſive ſublimate be mixed with the tar as quickly as poſſible after it is purchaſed; for, being of a very poiſonous nature to all animals, it ſhould not be ſuffered to lie about a houſe, for fear of miſchief to ſome part of the family.

Theſe obſervations are followed by ſeveral certificates, proving the advantage of the foregoing method of pruning, &c.

VI. Deſcription of a preſervative Wheel, to be fixed to a walking Wheel-Crane; whereby the Safety of the Men is inſured, ſhould the Weight at any Time overcome the Power. By Mr. JOSEPH DIXON, of Moore's yard, Old Fiſh-ſtreet.

WITH A PLATE.

From the TRANSACTIONS of the SOCIETY for the Encouragement of ARTS, MANUFACTURES, and COMMERCE.

A Bounty of Fifteen Guineas was voted by the Society to Mr. DIXON, for his Contrivance, the Deſcription of which is preceded by the following Letter to the Society.

My Lords and Gentlemen,

IT is well-known, that numbers of unfortunate men have loſt their lives by working on the quays in the wheel-cranes, by their recanting when overpowered by the weight craning up; and, having

ving no means whereby to ſave themſelves, have inevitably fallen a ſacrifice. It has long been my conſtant ſtudy to contrive ſome method to prevent thoſe fatal misfortunes; which I have at length accompliſhed, in what I call the preſervative wheel. I am now happy in offering it to your inſpection, and hope it will meet with your approbation. The preſervative wheels are fixed to the axis of the walking-wheel; over which paſs two ropes, ſuſpending a bar of wood, for the men to lay hold of, when overpowered; and by which they may ſuſpend themſelves, with the greateſt ſafety, till all danger is paſt. Pulleys are placed near the periphery of each of the preſervative wheels; over which the ropes run, and are thereby prevented taking fire by the friction. The preſervative wheels are made in two parts, in order that they may be fixed to any crane already erected. I am, &c.

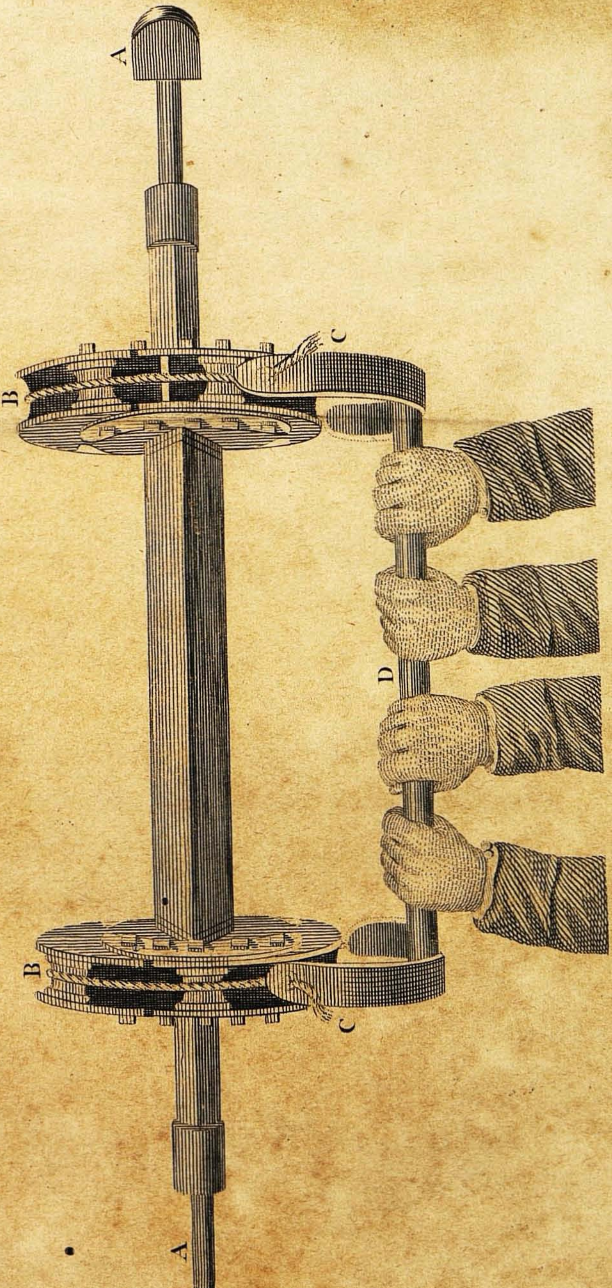
JOSEPH DIXON.

Deſcription of Mr. Dixon's Contrivance for preventing Accidents in Wheel-Cranes.

See Plate II.

AA. The axis or ſpindle of the walking-wheel. BB. two preſervative wheels, fixed on the axis, and having, near the peripheries, ſix pulleys, over which ropes run, that are faſtened at their extremities to two ſegments of circles C C. Theſe are united by a wooden bar D. which the men are to lay hold of, as expreſſed in the figure, and ſuſpend themſelves by, in caſe of danger.

VII.


A
B
C
D
B
C
A

VII. Defcription of a Method of caufing the Bobbin of the common Spinning-Wheel to move backward and forward, by which the Time loft in ftopping the Wheel, to fhift the Thread from one Staple to another, on the Flyer, is avoided; the Danger of breaking the Thread, and lofing the End obviated; and the Spinner enabled to do much more Work, in a given Time, than by any common Spinning-Wheel hitherto in Ufe. By Mr. John Antis of Fulneck, near Leeds.

WITH A PLATE.

From the Transactions of the Society for the Encouragement of Arts, Manufactures, and Commerce.

Twenty Guineas were voted to Mr. Antis, for his Invention.

In an introductory letter Mr. Antis obferves, that this contrivance may be added to old fpinning-

ning-wheels, of whatever conſtruction they may be; and that it would add very little to the expence of a new one, if made ſo from the beginning. He ſays alſo, that he had it tried by a lady who ſometimes ſpins for her diverſion, who was much pleaſed with the invention, and thought it might ſave a perſon at leaſt two hours, if not more, in a day.

In a ſecond letter Mr. Antis ſays—"Having had opportunity to try it ſufficiently, I do not at all doubt but it will anſwer. I made every thing as ſimple as poſſible, ſo that it might be in the pooreſt perſon's power to obtain it, and ſtill it could be more ſo; for, had I had a turner at hand, I would have made all on the wheel of wood; for, a good piece of hard ſycamore might have been ſo contrived, that, inſtead of the iron wire on the wheel, a rim might have been left ſtanding, and cut in the ſame ſhape, which would anſwer as well; only, in that caſe, the pin on the lever would be better if it were a roller. There is a ſmall lead weight, which goes over a pulley, and inclines the bobbin always one way."

"The

" The invention has alſo this advantage, that whereas, at beſt, the old method always winds in ridges; if a thread breaks, by reeling the yarn, one may as well throw the whole bobbin away, as the thread cannot eaſily be found again; but this always winds it acroſs upon one another, by which means the thread can never be loſt."

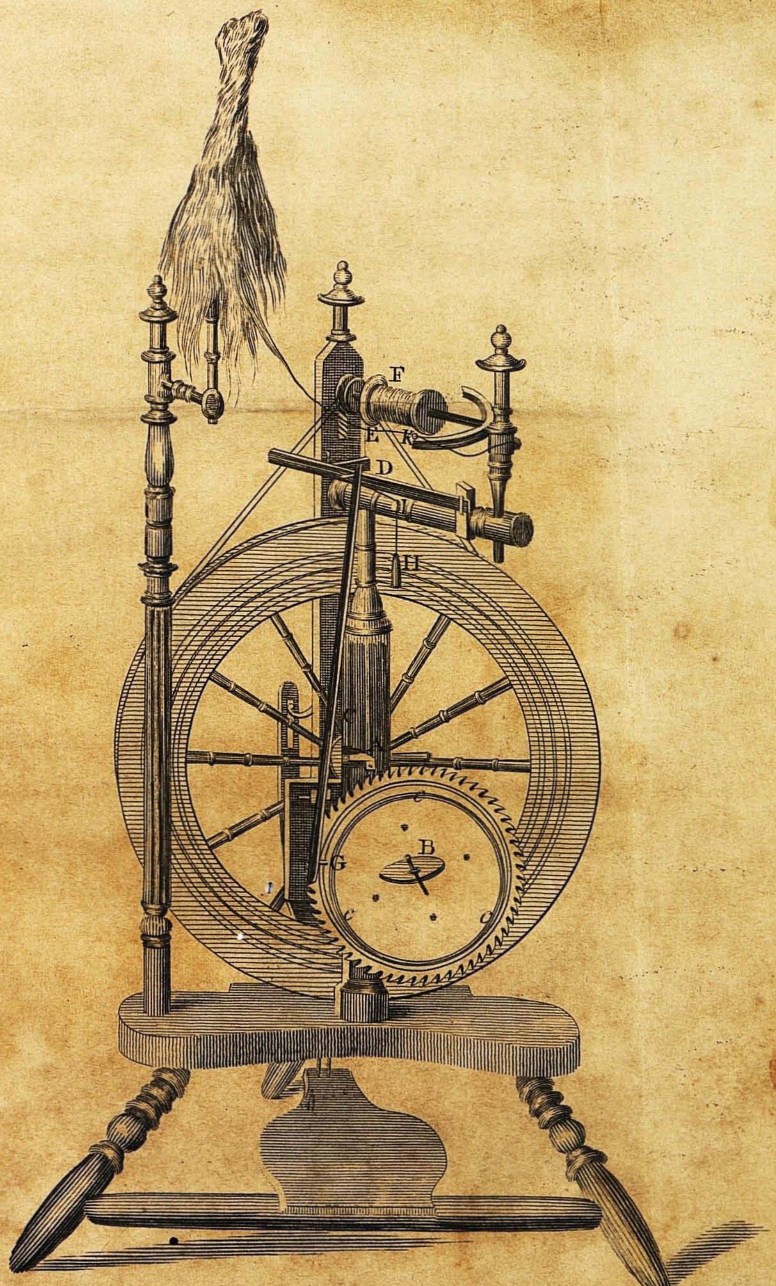
Deſcription of Mr. ANTIS's improved Spinning-Wheel. See Plate III.

The method of cauſing the bobbin to move backward and forward (which is the improvement here meant to be ſhewn) is effected by the axis of the great wheel being extended through the pillar next the ſpinner, and formed into a pinion of one leaf, A. which takes into a wheel B. ſeven inches diameter, having on its periphery ninety-ſeven teeth; ſo that ninety-ſeven revolutions of the great wheel cauſe one of the leſs wheel. On this leſs wheel is fixed a ring of wire *c c c*; which, being ſupported on ſix legs, ſtands obliquely to the wheel itſelf, touching it at one point, and projecting nearly three quarters of an inch, at the oppoſite one.

Near

Near the ſide of this wheel is an upright lever, C. about fifteen inches long, moving on a centre, three inches from its lower extremity, and connected at the top to a ſliding bar, D. from which riſes an upright piece of braſs, E. which, working in the notch of a pulley, drives the bobbin F. backward and forward, according as the oblique wire forces a pin G. in or out, as the wheel moves round. To regulate and aſſiſt the alternate motion, a weight H. hangs, by a line, to the ſliding-bar, and, paſſing over a pulley, I. riſes and falls as the bobbin advances or recedes, and tends conſtantly to keep the pin in contact with the wire. It is evident, from this deſcription, that one ſtaple only is wanted to the flyer, which being placed near the extremity, K. the thread paſſing through it is, by the motion of the bobbing, laid regularly thereon.

VIII.


F
E
K
D
I
H
C
A
B
G
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c

VIII. Deſcription of the Proceſs to be obſerved in making large Sheets of Paper in the Chineſe Manner, with one ſmooth Surface. Communicated by Dr. B. Franklin.

From the Transactions of the American Philosophical Society.

In Europe to have a large ſurface of paper connected together, and ſmooth on one ſide, the following operations are performed:

1. A number of ſmall ſheets are to be made ſeparately.

2. Theſe are to be couched, one by one, between blankets.

3. When a heap is formed, it muſt be put under a ſtrong preſs, to force out the water.

4. Then the blankets are to be taken away, one by one, and the ſheets hung up to dry.

5. When dry they are to be again preſſed, or, if to be ſized, they muſt be dipped into ſize made of warm water, in which glue and alum are diſſolved.

6. They muſt then be preſſed again, to force out the ſuperfluous ſize.

7. They muſt then be hung up a ſecond time to dry, which, if the air happen to be damp, requires ſome days.

8. They muſt then be taken down, laid together, and again preſſed.

9. They muſt be paſted together at their edges.

10. The whole muſt be glazed, by labour, with a flint.

In China, if they would make ſheets, ſuppoſe of four and a half ells long, and one and a half ells wide, they have two large vats, each five ells long, and two ells wide, made of brick, lined with a plaſter that holds water. In theſe the ſtuff is mixed ready to work.

Between theſe vats is built a kiln or ſtove, with two inclining ſides, each ſide ſomething larger

than

than the ſheet of paper; they are covered with a fine ſtucco, that takes a poliſh, and are ſo contrived as to be well heated, by a ſmall fire circulating in the walls.

The mould is made with thin but deep ſides, that it may be both light and ſtiff. It is ſuſpended, at each end, with cords that paſs over pulleys faſtened to the cieling; their ends connected with a counterpoiſe nearly equal to the weight of the mould.

Two men, one at each end of the mould, lifting it out of the water by the help of the counterpoiſe, turn it and apply it, with the ſtuff for the ſheet, to the ſmooth ſurface of the ſtove, againſt which they preſs it, to force out a great part of the water through the wires. The heat of the wall ſoon evaporates the reſt, and a boy takes off the dried ſheet, by rolling it up.

The ſide next the ſtove receives the even poliſh of the ſtucco, and is thereby better fitted to receive the impreſſion of fine prints. If a degree of ſizing is required, a decoction of rice is mixed with the ſtuff in the vat.

 Thus

Thus the great ſheet is obtained, ſmooth and ſized, and a number of the European operations ſaved. As the ſtove has two poliſhed ſides, and there are two vats, the ſame operation is, at the ſame time, peformed by two other men at the other vat; and one fire ſerves.

IX. Deſcription of a Spring-Block, deſigned to aſſiſt a Veſſel in Sailing. By FRANCIS HOPKINSON, Eſq. of Philadelphia.

WITH A PLATE:

From the TRANSACTIONS of the AMERICAN PHILOSOPHICAL SOCIETY.

The Magellanic Gold Medal was given to Mr. HOPKINSON, for this Invention.

IT is an acknowledged fact, that when the ſhrouds of a veſſel are braced very tight, ſo as to prevent the maſts from having any play or ſpring, ſhe will not ſail as faſt as when her maſts are permitted to bend a little to the impulſes of the wind. The

The reaſon is, that the wind is ſeldom uniform in its force for any length of time, and it is impoſſible that a ſudden increaſe of impulſe ſhould *inſtantaneouſly* communicate a proportionable velocity to ſo heavy a body, placed in a reſiſting medium of ſo great a denſity.

In ſuch caſe the veſſel is forcibly preſſed into or againſt the water, and is obliged to heel from the blaſt, until a progreſſive motion, adequate to the force impreſſed, can be communicated to the whole maſs. But theſe ſudden preſſures againſt the water, and this heeling of the veſſel, are great obſtacles to faſt ſailing; in as much as they occaſion an unprofitable expenditure of the force which ſhould puſh her forward.

When a veſſel firſt hoiſts her ſails, although ſhe may be in a ſituation to receive the full impulſe of the wind, yet ſhe will not *immediately* proceed with the velocity which ſhe will afterwards acquire from the ſame force; having not yet *got under way*, as the ſeamen expreſs it. Upon the ſame principle, when a veſſel is ſailing at the rate of five knots, if a ſudden blaſt of wind ſhould come, which would

would enable her to make ſeven knots, ſhe may be conſidered as being perfectly ſtationary with reſpect to the two additional knots, and will require ſome time to *get under way*, as to them. Now the effect produced by relaxing the ſhrouds is, that the maſt, receiving the firſt impreſſion of the wind upon the ſails, acts as a ſpring, and, yielding to the impulſe, gradually communicates motion to the whole veſſel, giving her time to *get under way*, and occaſioning an eaſy tranſition from one degree of velocity to another; ſo that her way is not checked by her being ſuddenly urged againſt the reſiſting medium, on the acceſſion of every new force impreſſed.

But the misfortune is, that the advantageous uſe of the maſt can be exerciſed only to a ſmall extent; for, if it is allowed too much play, it will be in danger of breaking.

The object of the preſent propoſal is, to enjoy the ſame benefit to a greater extent, and with more ſecurity.

The maſts, yards, and rigging, of a ſhip receive the firſt impulſes of the wind. All theſe are in

ſome

ſome degree elaſtic. Every twiſted-rope is a ſpiral ſpring, and every ſpar capable of being a little bent. But let us ſuppoſe that the ropes were all compoſed of ſtraight ſtrands, that the maſts and yards were inflexible, and the ſails made of thin light wood: In ſuch caſe, I ſuppoſe that the veſſel, in ſailing by the wind, would make but little head-way, whatever the ſhape of her bottom might be, but would expend the force of the wind in heeling, and ſlipping to leeward. If this is true, her ſailing muſt be conſiderably aſſiſted by any means that ſhall increaſe the acting ſpring of her rigging. For this purpoſe I have contrived what I call a SPRING-BLOCK, to be applied to all ſuch parts of the rigging as will admit of it with ſafety and convenience, and where its operation will be moſt advantageous; but particularly to the ſheet-ropes, and, if practicable, to the dead eyes, in lieu of what are called the chains.

Deſcription of Mr. HOPKINSON's Spring-Block. See Plate IV.

A. Fig. 1. is a block made in the uſual manner, having a ring or eye, B. at one end.

C. is

C. is a ſpiral ſpring, linked at one end to the hook DE. and at the other to the ring F. which is to be annexed, by a ſtaple, to the timber-head, or, by ſome other means, to the place where it is to be applied. The ſpring C. muſt be of well-tempered ſteel, and proportioned in ſtrength to the ſervice it is to perform. Within the cavity or pipe, formed by the ſpiral ſpring, there muſt be a *chain* of ſuitable ſtrength, called a *check-chain*, (repreſented ſeparate at G.) conected by the links to the hook DE. and ring F. When the ſpring is not in action, this chain is ſlack; but when the ſpiral ſpring is extended, by the force of the wind, as far as it can be without danger of injury, the check-chain muſt then begin to bear, to prevent its farther extenſion,, and, if ſtrong enough, will be an effectual ſecurity againſt failure.

Fig. 2. repreſents part of the gun-wale of a ſloop, with the ſpring-blocks in action, one of them hooked to a ſtaple in the timber-head, and the other to the corner of the jib.

My expectation is, that a veſſel thus furniſhed will be leſs liable to heel, that ſhe will receive the impulſes

Fig.1.

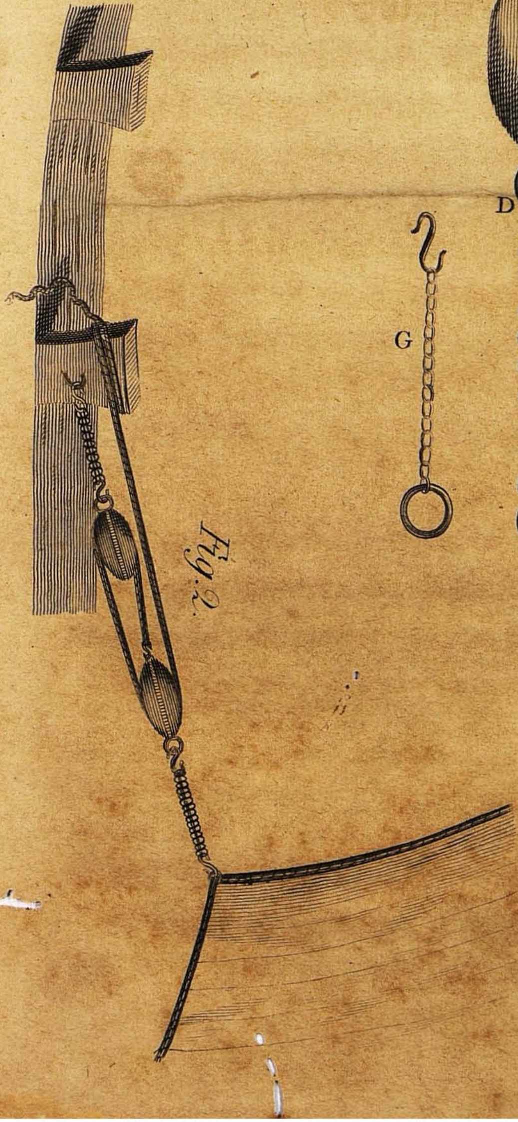


Fig.2.

impulſes of the wind to better advantage, and ſail with a more lively and equable motion than if rigged in the common way.

X. Deſcription of a Machine for meaſuring a Ship's Way; by Francis Hopkinson, Eſq. of Philadelphia.

From the Transactions of the American Philosophical Society.

IN the ſecond volume of our Philoſophical Tranſactions, I publiſhed a deſcription of an inſtrument for meaſuring a ſhip's way through the ſea. I have not heard of any objection to the principles on which ſuch a machine may be conſtructed; but it may, probably, have been thought too complex for general uſe.

As this object, ſhould it be accompliſhed, would be of great importance, I have made another at-

 tempt

tempt to the ſame purpoſe; in which, if there ſhould be no other objection, the want of ſimplicity cannot reaſonably be complained of.

Cloſe along the ſhip's bow is a copper pipe, about two inches in diameter, extending downward as low as the keel, and upward above the water-line, when the ſhip is loaded. This pipe muſt be ſo bent at the bottom, as that its orifice may be directly oppoſed to the line of the ſhip's progreſs, and project but a little way beyond the keel or cut-water. The upper part of this pipe muſt alſo be ſo bent as that it may enter into the forecaſtle, through a hole made for that purpoſe, above the water-line. The pipe ſhould be ſecured in its place by ſtaples or cramps.

On the top of this copper pipe ſhould be a cover, to be ſcrewed on; and through the cover a hole muſt be made for the admiſſion of a glaſs tube, of the ſize of a common barometer tube, and cemented there. The ſea-water will riſe in the copper pipe to the general level of the ſea, but will not appear in the glaſs tube, becauſe the copper pipe enters the ſhip above the water-line, as before

before obſerved. But, if a quantity of oil be poured down the glaſs tube, the ſurface of the oil will riſe, and becôme viſible in the tube, on account of the ſpecific difference between the oil and ſea-water.

This glaſs tube muſt alſo be furniſhed with a ſcale, for meaſuring the different heights of the oil; the cipher or (o) of the ſcale being on a line with the ſurface of the oil when the ſhip is at reſt, or makes no way. But, when ſhe is in a progreſſive motion, the water contained in the copper tube, together with the column of oil in the glaſs tube, will be forced upward, in proportion to the velocity with which the veſſel proceeds; which will be aſcertained by the different altitudes of the ſurface of the oil, viſible on the graduated ſcale.

The glaſs tube ſhould be made to run ſome depth into the copper pipe, and alſo be of a ſufficient height above, to allow room for the vibrations of the column of oil, when the ſhip is agitated by the waves.

When the ſhip has got every thing on-board, and whilſt ſhe is not under way, the ſurface of

 the

the oil muſt be regulated by bringing it even with the cipher or (o) of the ſcale; and this examination ſhould be frequently made, on account of the conſumption of proviſions, and other waſte, that may alter the ſhip's draught of water.

In taking down the reckoning from the ſcale, the moſt favourable moment ſhould be watched for a fair obſervation, viz. when the ſhip is proceeding with an uniform velocity; not when ſhe is in the act of plunging into, or riſing above, the level of the waves, as this would ſenſibly affect the truth of the ſcale.. But a little experience would ſoon make the uſe of the inſtrument familiar.

XI.

XI. Account of the Method of bleaching Cloths, and Thread, by the oxygenated muriatic Acid *; and of ſome other Properties of this Liquor, relative to the Arts. By Mr. BERTHOLLET.

FROM THE *ANNALES DE CHIMIE*.

WE owe to Scheele not only the diſcovery of the oxygenated muriatic acid, but alſo that of the effects which it produces upon the colouring parts of vegetables. "It is in its elaſtic ſtate (ſays that great chemiſt) that the qualities of this air are beſt diſcovered. In a ſand-bath is to be placed a glaſs retort, in which muriatic acid has been poured upon manganeſe; to this ſmall receivers are to be adapted, capable of containing about twelve ounces each, into which is to be poured about two drachms of water, without any other

* Called alſo dephlogiſticated marine acid.

lute

lute than a ſlip of blotting-paper about the neck of the retort. In about a quarter of an hour, a yellow air is perceived in the receiver, which is to be taken off. If the paper has been properly applied, the air ruſhes out forcibly; the receiver muſt be quickly ſtopped, and another applied. Thus many receivers may be filled with the dephlogiſticated muriatic acid; but it is neceſſary to place the retort in ſuch a manner that the drops which riſe into its neck may be able to fall back. The water ſerves to retain the vapours of the acid. I uſe many receivers that I may not be obliged to repeat a ſimilar diſtillation for every experiment. It is not proper to employ large ones, becauſe, every time they are opened, a great part of the acid is diſſipated in the air."

"What I ſubmitted to examination with this dephlogiſticated muriatic acid was placed in the neck of the receiver, which I had ſtopped."

"The cork was turned yellow, as by aqua fortis."

"Paper

"Paper tinged with turnſol became almoſt white; all red, blue and yellow flowers, as alſo green plants, turned yellow in a ſhort time, and the water in the receiver was changed into a pure but weak muriatic acid."

"Neither alkalies nor acids were able to reſtore the colours of the flowers, or of the plants."

I took up the experiments of Scheele, and I attempted to throw more light on the nature of the oxygenated muriatic acid, and upon its principal properties. I have ſhewn that one portion of the muriatic acid diſſolved the calx of manganeſe, and ſeparated a part of the baſe of vital air, or oxygene, (which was in exceſs in the calx of manganeſe,) that the diſſolution might be performed; that this oxygene, being in a non-elaſtic ſtate, or, according to the expreſſion of Doctor Prieſtley, in a naſcent one, and thereby very much diſpoſed to form new combinations, unites itſelf with another portion of the muriatic acid, and that this combination conſtitutes the oxygenated muriatic acid gas.

I ex-

I explained this theory in ſeveral memoirs which are in the collection of the academy for 1785, and the following years; and in the *Journal de Phyſique* for June 1785, and for Auguſt 1786. But, in order that perſons who are not verſed in chemiſtry may be able not only to execute the proceſs which I am about to deſcribe, but alſo to modify and extend it, I ſhall relate ſome experiments of which I have formerly given the detail, omitting the other parts of the theory that I may enlarge upon the compoſition of the oxygenated muriatic acid, and on the action which it exerciſes upon the colouring particles of bodies.

According to Scheele, "The muriatic acid deprived of phlogiſton, which is one of its conſtituent parts, does not unite with water but in very ſmall quantity, and does not render it very acid." He appears to have contented himſelf with examining the water which had not been in contact with the gas except during the time of the operation, and to have concluded therefrom that the gas was very ſlightly ſoluble therein; ſo that it appeared to him better to employ the gas itſelf in his

his experiments, than the water, which would but weakly impregnated; and which at the same time would contain a small quantity of muriatic acid, which comes over in the distillation, when the necessary precautions are not taken to retain it by an intermediate bottle.

The first object which I proposed to myself was to examine the solubility of the oxygenated muriatic acid gas in water, because I imagined, that, if I were able to obtain a slightly concentrated solution, it might be more easy to submit this liquor to different experiments than the gas itself. I soon perceived that this gas dissolved in water more readily, and in greater quantity, than carbonic acid gas, or fixed air; and that the water which was saturated with it acquired a very strong odour, a yellowish colour, and other properties very strongly marked. I have made my first trials by agitating water in contact with the gas, in the manner in which water is generally impregnated with fixed air; but the suffocating vapour which exhaled determined me to employ Mr. Woulfe's apparatus, instead of that process.

 I placed,

laced, between the retort and the bottles filled with water, (deſigned to be impregnated with the gas,) a ſmall bottle, which I ſurrounded with ice, to condenſe the muriatic vapour which was not oxygenated; I alſo ſurrounded with ice the bottles filled with water. I obſerved during this operation, that, when the water became ſaturated with the gas, this laſt took a concrete form, and fell ſlowly to the bottom of the water.

If there is filled with water, impregnated with the gas that is diſengaged, (that is to ſay with oxygenated muriatic acid,) a bottle having a long tube bent and plunged under a recipient filled with water, and this bottle is expoſed to the light of the ſun, bubbles are ſoon obſerved to be diſengaged, which paſs into the recipient, and which are of pure air (vital air, or oxygene gas); when the bubbles ceaſe to be diſengaged, the liquor has loſt its odour, its colour, and all its diſtinguiſhing properties; it is then no other than water impregnated with common muriatic acid. This ſimple experiment is ſufficient to convince us that the oxygenated muriatic acid is really

nothing

nothing but a combination of the muriatic acid with the base of vital air, or oxygene, which is in such quantity in the black calx of manganese, that we need only urge this calx by a violent heat, to draw off a great quantity; and then it is no longer proper for forming the oxygenated muriatic acid, inasmuch as it is deprived of that portion of oxygene which should combine with a part of the muriatic acid.

It is observable that light has the property of disengaging the oxygene which has combined with the muriatic acid, by restoring to it that elasticity of which it was partly deprived; which heat alone is not able to do. It appears that light combines with the oxygene, and that it is to this combination the elastic state of vital air is owing, which, in losing *afresh* its elasticity by combustion, (that is to say, by rapid union with certain substances,) lets also the principle of light escape, and at the same time much heat is disengaged; the true relation of which to light we are as yet ignorant of.

If vegetable colours are plunged into the oxygenated muriatic acid, they disappear more or less speedily, and more or less completely; when there is a mixture of different colouring particles, some of them disappear more easily, and admit only those to be perceived which offer a greater resistance, but which have nevertheless suffered a greater or less alteration. It is most commonly the yellow parts which resist the most, but all at last disappear; and, when the oxygenated muriatic acid has spent its power, it is brought back to the state of common muriatic acid; the colouring particles have therefore taken away its oxygene, and have acquired by that combination new properties, having lost that of producing colours. I shall not say any more at present about the properties of these oxygenated particles; the oxygenated muriatic acid evidently owe the property of destroying colours to oxygene, with which is is combined in great quantity, but with which it is very loosely connected, and therefore easily enters into combination with those substances which have any affinity with it. The affinities of these colouring particles (so various in nature) with oxygene, with

with light, with alkalies, and other chemical agents, cannot but form a very intereſting, and almoſt entirely new part of philoſophy.

After having obſerved the action which the oxygenated muriatic acid exerciſes upon colouring particles in general, I thought that it might produce the ſame effect upon thoſe which gave colour to thread and cloth, and which it is the object of bleaching to ſeparate or deſtroy. I ſhall not however merely deſcribe the proceſs as it is now practiſed, as I think it may be uſeful to thoſe who deſire to execute it, that I ſhould give the hiſtory of the imperfect trials with which I commenced.

At firſt I made uſe of a highly concentrated liquor, and I renewed it when it was exhauſted, until the thread or cloth appeared white; but I ſoon perceived that they were conſiderably weakened, and that they were entirely loſing their ſolidity. I then weakened the liquor a little, and I ſucceeded in bleaching cloth without damaging it. But it ſpeedily became yellow by keeping, eſpecially if it was warmed, or paſſed through an alkaline

kanne ley. I reflected upon the circumſtances of common bleaching, and I endeavoured to imitate its proceſs, becauſe I thought the oxygenated muriatic acid might act in the ſame manner as the expoſition of the cloth in the meadows, which alone does not ſuffice, but which appears only to diſpoſe the colouring parts of the cloth to be diſſolved by the alkali of the ley. I examined dew, not only that which falls from the atmoſphere, but alſo that which comes from the nocturnal tranſpiration of plants; and I obſerved that both of them were impregnated with oxygene, ſufficiently to deſtroy the colour of paper ſlightly tinged with turnſol. Perhaps the ancient prejudices concerning the dew of the month of May, a ſeaſon when the tranſpiration of plants is abundant, originated in ſome obſervations of this kind.

I therefore employed leys, and the action of oxygenated muriatic acid, alternately, and I then obtained a permanent white; and as, at the finiſhing of the common bleaching, the cloth is paſſed through ſour milk, or through vitriolic acid diluted with a very large quantity of water, I alſo tried

tried paſſing the cloth through a very dilute ſolution of vitriolic acid, and I obſerved that the white was thereby rendered more clear. As ſoon as I made uſe of leys *intermediately*, I found that it was not neceſſary to employ a concentrated liquor, or to let the cloth, at every immerſion, remain long therein; by this I avoided two inconveniences, which would have rendered this proceſs impoſſible to be practiſed in the large way. The firſt is the ſuffocating odour of the liquor, which it would be very inconvenient, and even very dangerous, to reſpire for a length of time, and which has diſcouraged many perſons who tried to uſe it; the ſecond is, the danger of weakening the cloth. I now alſo left off mixing any alkali with the oxygenated muriatic acid, as I had practiſed in the greateſt part of my firſt trials. (See *Journal de Phyſique* 1785.)

This is nearly the ſtate in which my experiments were, when I made ſome trials in the preſence of the celebrated Mr. Watt. A ſingle view ſufficed for a philoſopher whoſe genius has been exercifed ſo long upon the arts. In a ſhort time Mr.

Mr. Watt wrote to me from England, that even in the firſt operation he had bleached five hundred pieces of cloth at Mr. Grigor's, who has a large bleaching-ground at Glaſgow, and who continues to make uſe of the new proceſs. In the mean time M. Bonjour, who had hitherto aſſiſted me in my experiments, and who joins great ſagacity to a moſt extended knowledge of chemiſtry, aſſociated himſelf with M. Conſtant, at Valenciennes, in order to form an eſtabliſhment in that city. This ſcheme was thwarted by prejudice, and by the intereſt of the bleachers, who feared the competition of a new method. M. Conſtant could not even procure a piece of ground in the city of Valenciennes; but the Count de Bellaing favoured this enterpriſe, and let him have a piece of ground which appears to have all the neceſſary conveniences, but which, being at a certain diſtance from Valenciennes, will on that account have a diſadvantage if any eſtabliſhment ſhould be formed in that city. M. Bonjour had abandoned thoſe well-founded hopes which his knowledge and talents gave him at Paris; and found, in the enterpriſe to which he had devoted himſelf, nothing

thing but thoſe vexations which uſually accompany the introduction of new proceſſes in the arts. He addreſſed himſelf to the *Bureau de commerce*, not to make advantage of the ſervice he ſhould render, but to deſire they would protect him from the diſadvantages and obſtacles which the prejudices and oppoſite intereſts he had met with at Valenciennes had prepared for him; by allowing him a circle of two leagues round Valenciennes and Cambray, in which he alone might, for ſome years, have the privilege of exerciſing the new art, without putting any conſtraint upon the liberty of thoſe who wiſhed ſtill to employ the ancient proceſſes, or to try new ones in which the oxygenated muriatic acid ſhould not be uſed. He offered in his eſtabliſhment to inſtruct, in all the details of the proceſs, all thoſe who were willing to make uſe thereof, and who ſhould have the approbation of adminiſtration. Perhaps, if his deſire had been granted, the eſtabliſhment at Valenciennes would have given more confidence to thoſe who undertook to advance the neceſſary capital. They would probably have confined their attempts to that place, inſtead of introducing the proceſs

Courtray, as they have juſt done; and many artiſts would have perfected themſelves under M. Bonjour, who might by this time have formed a great number of eſtabliſhments in our provinces, avoiding thereby thoſe unprofitable trials which might give diſcredit to an uſeful art.

When I conceived the hope that the proceſs might be executed in a large way, I ſought to diminiſh the price of the liquor, by decompoſing the ſea-ſalt in the ſame operation which ſerves to make the liquor itſelf; but, whether I employed vitriolic acid too highly concentrated, or whether the proportions of the ingredients were erroneous, I obtained only a ſmall quantity of liquor; which made me judge that it was better to make uſe of muriatic acid, and I employed it in the proportion which I have pointed out in my firſt memoirs; that is to ſay, I diſtilled three parts of concentrated muriatic acid with one part of calx of manganeſe. But an experienced chemiſt of Rouen, M. Decroiſille (who alſo made ſome experiments, with the view of forming an eſtabliſhment in that city) publiſhed, in the *Affiches de Normandie*, that

he

he had found a method of procuring the oxygenated muriatic acid, at much leſs expence than by the proceſs which I have deſcribed. I immediately began to make freſh trials; I gave the care of them to Mr. Welter, a young and ingenious chemiſt, who obſerved to me that it would be advantageous to weaken the vitriolic acid; and the operation ſucceeded in a ſatisfactory manner. I informed M. Bonjour and Mr. Watt thereof. The latter informed me, that he had made this alteration in his very firſt trials; a long time afterwards, M. Chaptal alſo deſcribed this operation in a memoir which he ſent to the Academy of Sciences. This is not the only alteration which Mr. Watt had made; he had alſo ſubſtituted a kind of tub, the conſtruction of which I am ignorant of, in lieu of Mr. Wolfe's apparatus, which I had uſed. But, before Mr. Watt had informed me of his apparatus, Mr. Welter had thought of one which is not only very convenient for the preparation of the oxygenated muriatic acid, but is alſo very proper for many other chemical operations, and of which I am about to ſhew the conſtruction, with ſome advantageous alterations, which M. Molar

has made. A particular defcription of it will be found in the plate and its explanation, which are at the end of this account.

The defign of this apparatus is to multiply the furfaces by which the gas comes in contact with the water; for, it is only at thofe points of contact that the combination can take place; that part of the gas which has not entered into combination in the lower gas, where it is firft conducted, paffes into the cavity which is over it, by the tube which is deftined to give it iffue. The veffel which is fituated between the pneumatic tub and the diftilling matrafs, is intended to retain that part of the muriatic acid which does not become oxygenated; there is put into this veffel a fmall quantity of water, into which a glafs tube is plunged, which ought to furpafs in height that column of water by which the emiffion of the gas is refifted in the tub. The gas which comes from the matrafs compreffes the water which is in this veffel, with a force equal to that which is oppofed to its emiffion, in fuch manner that the water rifes in the tube of fafety, and forms a column equal to that of

of the water which preſſes upon the tube by which the gas paſſes into the tub: but if, during the operation, either a ſudden cooling, or a rapid abſorption of the gas, takes place, the water deſcends again in the tube, and the atmoſpheric air enters and hinders a vacuum from being formed, which would occaſion the regurgitation of the liquor, and would break the diſtilling veſſel. This tube of ſafety, which was alſo contrived by the ingenious Mr. Welter, may be applied with ſucceſs to other pneumatic diſtillations, of which an example may be ſeen in the plate.

TO BE CONTINUED IN OUR NEXT.

XII. On the Method of making Inftruments of Elaftic Gum, with the Bottles that are brought from Brazil, by M. GROSSART (CHIRLY).

FROM THE *ANNALES DE CHIMIE*:

CAOUTCHOUC, or elaftic gum, is a fubftance which has engaged the attention of philofophers ever fince it has been known. Its fingular elafticity, its flexibility, and the little action moft fubftances have upon it, have caufed it to be confidered as very valuable for many purpofes, particularly in the art of furgery. But it has hitherto been impoffible to procure inftruments of this fubftance, inafmuch as almoft the whole quantity of caoutchouc brought into Europes comes from Brazil already fafhioned into bottles, birds, or other figures; this has rendered its ufe extremely circumfcribed.

It

It is known that these are made, in that country, by means of moulds, with the juice of a tree of the order of Euphorbiæ. The liquid is drawn from the tree by incision, and it thickens in the manner of resinous juices. It would be easy, could we procure it in its original state of fluidity, to give it all the forms under which it might be useful to us; but the communications with Brazil are very difficult for the greatest part of Europe; and the necessity of passing the line, in bringing it to our parts, is another obstacle to the juice arriving in a proper state for our purposes; as it is decomposed by heat in the same manner as milk, exhaling at that time an extremely fetid odour, and having no longer its original properties. Sir Joseph Banks, president of the Royal Society of London, so well-known by the voyage round the world, which his attachment to the sciences prompted him to undertake, told me he had had a bottle of it in its original state, but which after a little time became decomposed: since which he had not been able to procure any more from Lisbon, although he had offered even to the value of fifty guineas for a second bottle.

Most

Moſt of the perſons to whom the liquid has been ſent, whether from Cayenne, or from the Iſle of France, (where the tree that furniſhes this liquor is alſo known,) have never received it but in a decompoſed ſtate. I had for ſome time about a pint of it in that ſtate; it was given to me by M. d'Arcet, to whom ſome had been ſent from the Iſle of France. It was kept ſeveral winters in a room without a fire; but, after the hard froſts of 1788-9, I found the bottle broke. I think it may be uſeful to take notice of this accident, as the like, moſt probably, has not been recorded. I am not able to point out, either at what degree of temperature the decompoſed liquor paſſed to the ſolid ſtate, or in what manner it cryſtalliſed; becauſe I did not go into the place where it was kept until the weather had become much milder.

TO BE CONCLUDED IN OUR NEXT.

REPERTORY

OF

ARTS AND MANUFACTURES.

NUMBER II.

XIII. Specification of the Patent granted to JOHN BELLAMY of the Pariſh of Saint Mildred, in the City of London, Gentleman; for his Invention of a Method of making all Kinds of Leather, and various other Articles, Water-proof.

Dated January 9, 1794.

TO all to whom theſe preſents ſhall come, &c. NOW KNOW YE, that, in compliance with the ſaid proviſo, I the ſaid John Bellamy do hereby declare, that my ſaid invention of an improved

method of making all kinds of leather, and various other articles, water-proof, for the purpofe of being made up, and ufed in a variety of neceffary articles of confumption, is defcribed in manner following; that is to fay, firft method. Take nut-oil one gallon, poppy-oil one gallon, linfeed-oil two gallons. Or take nut-oil one gallon, linfeed-oil three gallons. Or take poppy-oil one gallon, linfeed-oil three gallons. Or take linfeed-oil two gallons, poppy-oil one pint, nut-oil one pint. Then take the above-named linfeed-oil, with the nut and poppy-oils, together or feparate, or without them. Or take the nut and poppy-oils, with any other drying-oil, or with the linfeed-oil, in any other quantity which by experience may be found advifable, (but the above proportions I think beft,) and put the afore-mentioned oil or oils, according to the above, or any other proportion, into an iron veffel, for it will be neceffary to vary the proportions according to the nature of the oil, and alfo according to the nature of the leather, or other article; for the fame kind of oil will not always have exactly the fame qualities. Oils of different expreffions will frequently

frequently have a greater or leſs propenſity to finiſh, and muſt, on that account, have more or leſs of the poppy or nut oils; for, if the drying oil finiſh reluctantly, there muſt be added a leſs, or leſs quantity ſtill, or none (if neceſſary) of the nut or poppy oils, and a ſmall quantity of an eſſential oil added, till it will finiſh with eaſe and beauty. The ſame kind of leather will alſo require a different mode of treatment; for, if the leather be new, it will abound more with the natural greaſe of the animal which produced it, and will require the oil or oils to be ſo managed as to abſorb or neutralize the greaſy quality, that it may finiſh without loading the leather, and making it unpleaſant to the wearer. When this is the caſe, one-fourth part of eſſential oil of turpentine muſt be mixed with the above oil or oils when prepared; and *vice verſa* if the leather is old. Yet the two different kinds of leather will finiſh with either way of preparing the oil or oils, but the above method I think beſt; and ſet it over a gentle fire, and to every gallon of oil or oils put half a pound of umber, or white copperas, ſugar of lead, colcothar, or any other proper dryer;

 or

or the fame proportion of any of them, or of all of them mixed together, or any other proper proportion; always obferving to ufe a larger proportion than the above when the oil is to be prepared for the new leather, and the above, or a lefs proportion, when it is to be prepared for old; or without any of the above ingredients; for it will anfwer either way, but the firft is preferable. Let it abide on the fire, and give it as great a degree of heat as it can bear without burning it, or caufing it to rife, for fix or feven hours, and, if it will not dry fufficiently, give it the fame degree of heat till it does. Then take it off the fire, and, when it is a little cooled, it is ready for ufe, to be applied to make water-proof leather and other articles, in the manner which will be given hereafter in No. III.

Second Method. To one gallon of the above prepared oil or oils, (which in this and the following muft be ufed as a menftruum to diffolve and unite with the articles hereafter fpecified,) add one pound of gum-refin, half a pound of pitch, quarter of a pound of tar, quarter of a pound of

turpen-

turpentine. Or to one gallon of the above prepared oil or oils, add one pound of gum-resin, one pound of pitch, half a pound of tar, half a pound of turpentine. Or take of the above prepared oil or oils two pounds, tar half a pound, resin half a pound, pitch half a pound. Or to two pounds of the above prepared oil or oils, add half a pound of tar, half a pound of resin. Or, to two pounds of the above prepared oil or oils, and half a pound of pitch, half a pound of tar. Or, to the above prepared oil or oils two pounds, add one pound of tar. Or take equal parts, in weight, of the above prepared oil or oils, and tar, resin, pitch, and turpentine. Or take equal parts in weight, of the above prepared oil or oils, and resin. Or take equal parts, in weight or measure, of the above prepared oil or oils, and tar, pitch, and turpentine. Or take equal parts, in weight or measure, of the above prepared oil or oils, and turpentine. Or take equal parts, in weight or measure, of the above prepared oil or oils, tar, and turpentine. Or take equal parts, in weight or measure, of the above prepared oil or oils, and one fourth part, in weight, of resin. Or take of the

the above prepared oil or oils, and one half part, in weight, of resin. Or take of the above prepared oil or oils, and of the gums sandarac, mastic, anime, copal, amber, together or separate, according to the above proportions. Or take asphaltum or Jew's-pitch, with the above prepared oil or oils, together or separate, agreeable to the above proportions. Or take, to one gallon of the above prepared oil or oils, equal parts, in weight or measure, of resin or pitch. Or take, to one gallon of the above prepared oil or oils, equal parts, in weight or measure, of either resin or pitch. Or take, to one gallon of the above prepared oil or oils, one pound and a half of resin, and half a pound of pitch. Or take, of the above prepared oil or oils, one gallon, or eight pounds, and one-sixth part of bees-wax. Or take of the above prepared oil or oils one gallon, and one-eighth part of birdlime. Or less or more of each, together or separate, or part of any of them; as they will answer if taken in a less or larger proportion; (provided the increased quantity does not render the leather hard or disagreeable, or that a less quantity does not answer the desired end;) but the

above

above propotions I think beſt. Or take any bituminous, reſinous, glutinous, oleous, or adherent matters (except the gum commonly called elaſtic gum, or India rubber), which will reſiſt acids, alkalies, and water, and that will unite with drying oils; for ſuch things are proper for making leather, and other articles, water-proof, provided, when mixed according to the above or any proper proportion, they do not render the leather hard, or make it crack, or otherwiſe diſagreeable. Let them be well incorporated with the oil or oils, by firſt heating the whole maſs gently, and then increaſe the fire till the whole is thoroughly mixed.

Method of uſe. When the above prepared oil or oils, agreeable to the firſt method, or the gum or gums, reſins, or bituminous or glutinous matters, agreeable to the ſecond method, together or ſeparate, are ſufficiently cool, take a bruſh, dip it in the above prepared matter or matters, agreeable to the firſt or ſecond method, and rub or bruſh it into the leather, or other articles, or make uſe of any other method which may be

 found

found preferable. When the article is well-filled with the aforefaid matter or matters, lay it on an even board, and fcrape off what is fuperfluous with a thin iron tool; then put it to dry in a warm room, and when fufficiently dry it will be fit for ufe. For fole-leather, and other thick fubftances, take the fole leather, or other thick fubftance, let it be gently warmed, and, with a brufh or pad, made of wool, or hair, or any other proper materials, rub or brufh on the leather, or fubftance, the above prepared matter or matters till it is thoroughly faturated, or without thoroughly faturating it, or make ufe of any other mode which may be found preferable, (but the above I think beft,) then let it dry in a warm place, and it is then ready for ufe. In witnefs whereof, &c.

*** *In a future number will be given a very interefting paper on the means of rendering leather water-proof; being an anfwer to a prize-queftion propofed by the Academy of Lyons on that fubject.*

XIV.

XIV. Specification of the Patent granted to Edward Rowland, and Exuperius Pickering, of the Parish of Ruabon, in the County of Denbigh, Gentlemen; for their Invention of an improved Method of constructing navigable Canals, without the Use of Locks or inclined Planes, whereby most of the Objections to, and Inconveniences arising from, Canals are effectually removed.

Dated March 18, 1794.

To all to whom these presents shall come, &c. Now know ye, that, in compliance with the said proviso, we the said Edward Rowland and Exuperius Pickering, do hereby declare, that our said invention is described in manner following; that is to say, first, in order to erect our machi-

nery, for the purpose of raising a commercial boat from a lower canal to an upper one, or lowering the same from an upper canal, a space of land, on a horizontal plane, betwixt the upper and the lower canal, will be necessary. The length and breadth of such space of land to be according to the size of the machinery; and the size of the machinery to be in proportion to the dimensions of a commercial boat and lading, of any respective canal, and which the machinery may be intended to convey. The difference of the height of the two canals may be from one foot to an hundred, as the machinery in question may be built to serve any intermediate height, or greater if necessary. In the space of land above-mentioned must be made a well, whose depth must be as much as the perpendicular height of the upper canal from the lower, with a farther allowance for the depth of a diving chest, intended to be put therein. (The magnitude of the diving chest will be described hereafter.) The width of the well, if for boats of twenty-five to twenty-eight ton burden, may be ten feet, and length from forty-five to forty-eight feet, and so in proportion

to any other ſized boats. The top of the well to be rather below the plane of the bottom of the lower canal; the well to be filled with water, and to contain a diving cheſt, which is intended to be ſunk or raiſed in the well at pleaſure. The diving cheſt may be made in manner and form of a boat, but cloſed at top, and that ſo exactly that no water ſhall be admitted, though ſunk to the bottom of the well. Its dimenſions, if for boats of twenty-eight ton burden, muſt contain eighteen hundred cubic feet vacuity, which would require a preſſure of fifty ton weight, in order to immerge it in water. The weight for the aforementioned purpoſe, and to balance it exactly, may be conſidered; firſt, pillars upon the diving cheſt, of a length equal to the height of the upper canal from the top of the cheſt, when juſt immerged in the water of the well, and which may be made of iron or wood, at the diſcretion of the builder; ſix or eight will generally be ſufficient. The pillars, if made of iron, and of ſufficient ſtrength, and twenty-one feet long, (which will be a length moſt ordinarily uſeful,) will be about ſix ton weight; but the length of the pillars will intirely depend

 upon

upon the height of the upper canal from the lower one. Upon the top of the pillars muſt be fixed a cradle, to be made in the ſhape of a boat, and of a ſize juſt ſo much larger as will admit of a commercial boat within it; the cradle to have a door or ſlide at each end, to be opened and ſhut occaſionally. The doors or ſlides to be juſt ſo much wider than a commercial boat as will give room for a boat to float in and out of the cradle freely. The doors or ſlides of the cradle to be fitted ſo exactly that, when leathered in the joints, and ſhut or put down, no water may be loſt. The weight of the cradle will be about ſix ton, and the water that it muſt contain, in order that a commercial boat may float in and out, will be about thirty-eight ton; the whole of the weight, pillars ſix ton, cradle ſix ton, water in the cradle thirty-eight ton, in all fifty ton. The diving cheſt thus balanced, the commercial veſſel coming into or out of the cradle will make no difference to the balance; for, when the boat with its freight enters the cradle, it diſplaces as much water as its own weight, and, when the boat leaves the cradle, as much water ſucceeds as keeps the machine in equilibrium.

At

At the end of each canal that correſponds with the land wherein the machinery is erected, muſt be gates or doors, ſuch as would be neceſſary to communicate with a common lock; with this difference only, the gates or doors of the lower canal need not be higher than the water in the lower canal, and to open the contrary way. As one end of the cradle will correſpond with the gates of the lower canal, when lowered to the ſame plane, the framing of the doors or gates of ſuch lower canal muſt be made to fit the correſponding end of the cradle, and jointed ſo exactly that, when covered with leather, or wadding of oakum, and drawn forcibly together by dogs or ſcrew-bolts, no water may be loſt. The ſame muſt be obſerved of the framing of the gates or doors of the upper canal, and which muſt be made to fit the correſponding end of the cradle, when the cradle is drawn up to the ſame plane with the upper canal, in all reſpects as the other before-mentioned. When the commercial boat is intended to be conveyed from the canal to the cradle, the cradle is to be bolted or ſcrewed to the framing of the doors of the canal, and then the door or ſlide

of

of the cradle drawn up or opened, and the doors of the canal opened; the boat is then free to float into the cradle. Then, the door and ſlides of the canal and cradle being ſhut, and the bolts drawn back or unſcrewed, the cradle is prepared for aſcending or deſcending, according to its reſpective ſituation. It may be worked by a rack and pinions; or with a capſtan with ropes, &c. A frame muſt be made from the bottom of the well to the height of the upper canal, on both ſides of the machinery, for the whole to ſlide up and down it with freedom and exactneſs; and with rollers at the ſides and ends of the cradle and diving cheſt, to prevent any great degree of friction. It would cauſe the machinery to move with greater exactneſs if, on the ſides and near each corner on the top of the framing, there was a large pulley for a rope to paſs over: one end of which rope ſhould be faſtened to the cradle, and at the other end a weight ſuſpended. The weight may be of any magnitude that may be found convenient to regulate the machinery; for inſtance, ſuppoſe four, two on each ſide, of one ton weight each, then the diving cheſt may be made proportionally leſs,

the

the weight anſwering the ſame purpoſe as the vacuity in the diving cheſt, and the whole load that reſts upon the pillars may be balanced by weight alone, and do without the diving cheſt and pillars, if in any particular ſituation it ſhould be found difficult to make a well with ſecurity. In our models we find only this difference, that the balancing by weight is a cauſe of greater friction, and will require a framing ſo much the ſtronger in proportion to the number and magnitude of the weights employed, and alſo a capſtan ſuch that a horſe may be applied to; in order to work the machinery, the weights may be connected to the cradles either by ropes or chains. It muſt be obſerved, that the machinery, when erected with the diving cheſt and prepared for deſcending, that the pillars, whether of iron or wood, as they deſcend into the water, loſe, if of iron, ſome of their abſolute gravity, if of wood, the whole. In order to regulate the difference that will be cauſed by the pillars deſcending in water, it will be neceſſary to have a conical barrel, with a weight and rope proportionate, to regulate the difference; the weight to be ſo applied as to aſſiſt in forcing down the cradle,

cradle, in proportion as the pillars loſe of their gravity. The machine, whether with weights or a diving cheſt for a balance, will act with the ſame uniformity with reſpect to the cradle that receives the commercial veſſel, and will make no other difference but the quantity of friction, in one caſe more than the other. Farther, if a commercial boat be empty, or but half laden, it will make no difference to the machinery acting, as a portion of water will always remain in the cradle, proportionate to the levity of the commercial veſſel and its freight. The machine with the diving cheſt may, in ſome ſituations, be applied with advantage to the uſe of water-engines for mines of manufacturing of iron, cotton, &c. In witneſs whereof, &c.

XV.

XV. Specification of the Patent granted to Mr. JAMES KING, of Newcastle upon Tyne, Merchant; for his new-invented British Barilla.

WITH TWO PLATES.

Dated March 4, 1780.—Term expired.

TO all to whom these presents shall come, &c. Now KNOW YE, that, in compliance with the said proviso, I, the said James King, do hereby declare, that my said invention of a material, called the new-invented British-Barilla, for the making and manufacturing crown window-glass, broad window-glass, and glass bottles; and also for the manufacturing of soap and alum, to much greater advantage than any other material hitherto used in the manufacturing of those commodities, is made, composed, and produced, in the manner following; that

that is to ſay, a quantity of aſhes, obtained from burning the loppings or branches of aſhwood, oak, beech, elm, alder, and any other kind of green wood and bramble, being the produce of this kingdom, in the proportion of one fourth part; and alſo a quantity of the aſhes obtained from burning the green vegetables known by the names fern, brecon, bean and pea ſtraw, and whin-aſhes; alſo common field and highway thiſtle, the ſtalks of rape-ſeed and muſtard-ſeed, and the bent or ruſhes that grow by the ſea-ſhore, in the proportion of one fourth part; the aſhes burnt from theſe vegetables, and the green wood, being ſifted through a fine ſieve, are laid down upon a boarded floor, and thereto added a quantity of ſoapers, waſte aſhes, in the proportion of two-fourth parts; theſe being all blended together, by turning them backwards and forwards, and thoroughly intermixed with a ſhovel, there is added, of fine quick-lime, in the proportion of about one hundred weight to the quantity of twelve hundred weight of the above blended or intermixed aſhes, with which the lime is alſo blended and thoroughly intermixed in the ſame manner as aforeſaid. This done,

done, they are taken up from the boarded floor, and put into an iron pan; (a draught of which is delineated in the paper hereto annexed;) then a sufficient quantity of sea-water is poured in, to dissolve the ashes, lime, &c. and the whole mass is stirred together with an iron rake, to incorporate; which done, a coal-fire is lighted up under the pan, and kept burning two days and two nights without intermission, still keeping the pans supplied with sea-water, in order to impregnate these materials with a greater degree of the saline quality, until it acquire strength sufficient for calcination in a reverberating furnace, known in this country by the name of calcar; (a draught of which is also delineated in the annexed paper;) and in this calcar, by means of an intense heat, the saline mass boiled in the pan is dissolved, and kept in a state of fusion for the space of an hour, in which time the volatile part flies off, and leaves remaining a fixed alkaline salt, which, cooled in iron pans, produces our British barilla, and has the appearance of Spanish barilla. In witness whereof, &c.

Explanation of the Plates.

(See Plates V. and VI.)

Plate V. Fig. 1. The platform of the furnace, on which the iron pan is to ſtand.

A. The grate-room, where the fire is put.

B. The door of the furnace.

C. The body of the furnace.

D. The chimney, to take away the ſmoke.

Fig. 2. E. The iron pan.

Plate VI. The melting furnace or calcar.

A. The door of the grate-room, where the fire is put.

B. The grate-room.

C. A wall to ſeparate the fire from the ſtuff laid upon the bottom at D.

D. The bottom of the calcar.

E. E. Two apertures, to let out the ſmoke.

Fig.1.

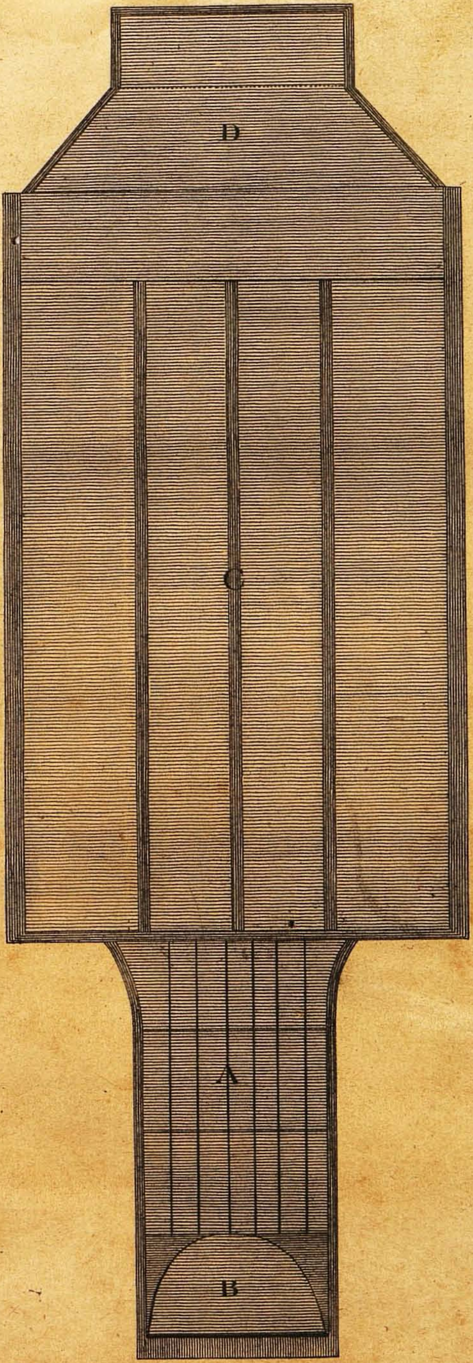
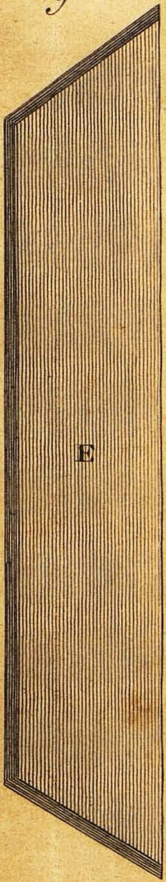
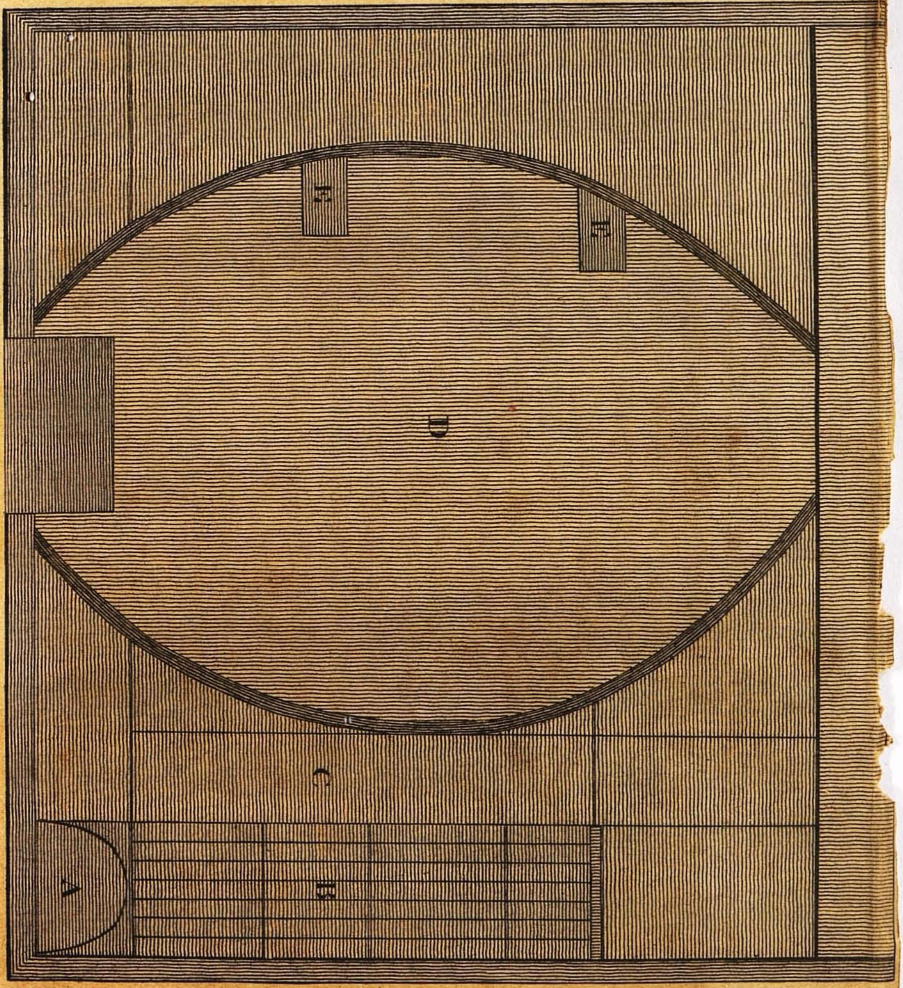


Fig.2.




E
E
D
C
B
A

XVI. Deſcription of a Machine for twitching Wool; a Work hitherto done by Hand, and, from the Films and Duſt, highly prejudicial to the Perſons employed in it; by Mr. Hugh Hughes, Millwright, of Coggeſhall, Eſſex.

WITH A PLATE.

From the TRANSACTIONS of the SOCIETY for the Encouragement of ARTS, MANUFACTURES, and COMMERCE.

A Bounty of Twelve Guineas was given to Mr. HUGHES for this Invention.

THE deſcription of this machine is accompanied by two letters from Mr. Hughes: the ſecond is in anſwer to one from the ſociety; deſiring him to explain what was meant by the word *twitching*,

ing, as it appeared to be a local term; and what word was made ufe of, for the fame operation, in other parts of the country. Extracts from thefe letters are given below.

It is alfo accompanied by feveral certificates, ftating, that the machine performs its operation in a very expeditious and complete manner, and that it is the moft ufeful one ever invented for baize-makers, clothiers, and other manufacturers of wool.

Extract from Mr. HUGHES's firft Letter.

"My own machine, which is now at work, is at Mr. Richard White's, baize-maker, in Great Coggefhall, Effex, whofe horfe-wheel is ten feet diameter; the next wheel, or the crank, is four feet diameter; and the wheel which drives the machine is four feet alfo, and drives four machines in work at once, three times backwards and forwards. It works to much greater advantage, and with more eafe, than any machine hitherto difcovered for this purpofe; has little friction; may be worked by hand, by water, by wind, or

 by

by horſe; and will be found very uſeful for driving calenders for glazing of cloth."

Extract from Mr. HUGHES's ſecond Letter.

"The uſe of my machine is for opening and preparing the wool for the carders and ſpinners, which was formerly done by men beating it with ſticks, called rods. But of late the method has been to uſe mills, called here *gigging-mills*, which in Yorkſhire are called *towing-mills*. Theſe are worked by men turning them backward and forward till the wool is ſufficiently opened for uſe."

Deſcription of Mr. HUGHES's Machine for twitching Wool. See plate VII.

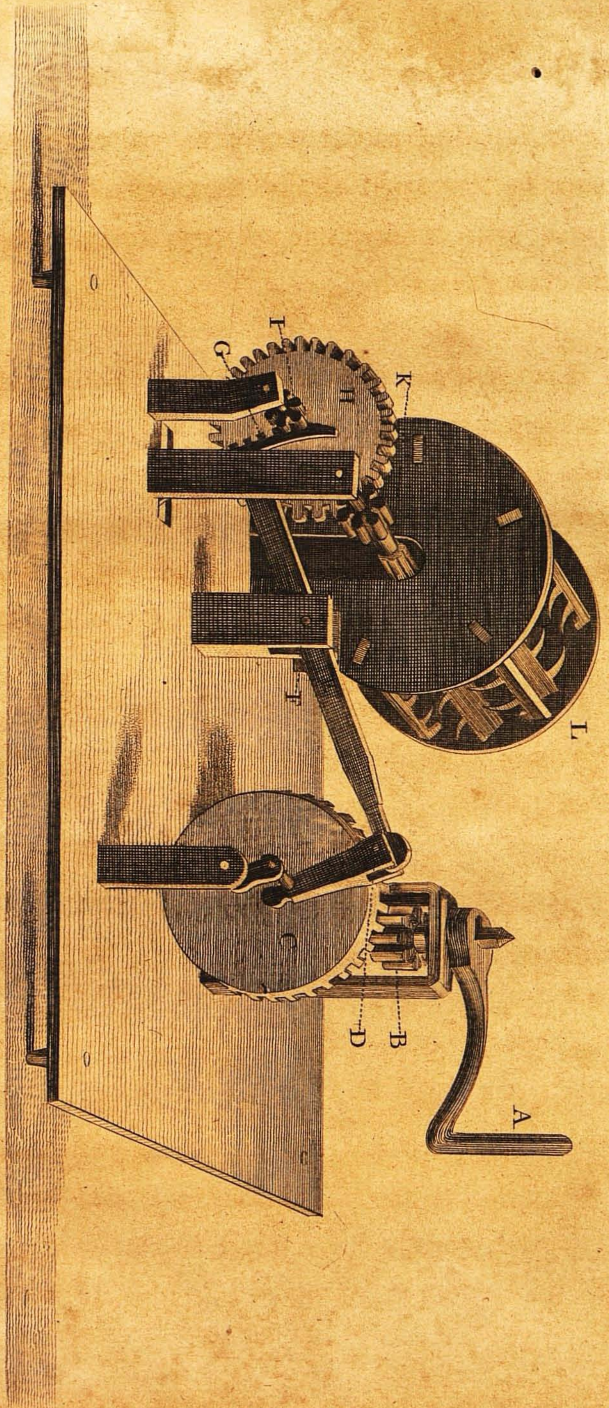
A, the winch by which the pinion B is turned; this pinion taking into the teeth of the face-wheel C, on whoſe axis is the crank D, an alternate motion is communicated to the bar E, moving on the axis F; and thus the horſe-head G drives the wheel H to the right or left, as the teeth of the horſe-head take into the pinion I and the teeth of the wheel H, taking into the

pinic

pinion K, fixed on the axis of the twitching machine L, the fangs on the fliers are alternately driven, with confiderable velocity, firft one way, and then the other.

A cover is placed over the part into which the wool is put, to prevent the inconveniencies arifing from the fmall particles of wool, that are driven about during the operation, to the great detriment of the workmen employed in the hand-machines ufed before this contrivance.

It will be eafily feen, by any mechanic, how this machine may be fixed to a horfe-mill, water-wheel, &c.


A
B
D
F
G
K
L

XVII. Method of curing the Diſorder of Sheep called the Scab; communicated by Sir Joſeph Banks, Bart. Preſident of the Royal Society, to the Society for the Encouragement of Arts, Manufactures, and Commerce.

From the TRANSACTIONS of the latter.

TAKE one pound of quickſilver, half a pound of Venice turpentine, half a pint of oil of turpentine, four pounds of hog's lard; let them be rubbed in a mortar, till the quickſilver is thoroughly incorporated with the other ingredients; for the proper mode of doing which, it may be neceſſary to take the advice, or even the aſſiſtance, of ſome apothecary, or other perſons uſed to make ſuch mixtures *.

* Though there does not appear to be any difference between this ointment and the *unguentum cæruleum* of the ſhops, I have choſen to give the receipt exactly as it was given to me.

The method of uſing the ointment is thus. Beginning at the head of the ſheep, and proceeding from between the ears along the back to the end of the tail, the wool is to be divided in a furrow till the ſkin can be touched; and, as the furrow is made, the finger ſlightly dipped in the ointment is to be drawn along the bottom of it, where it will leave a blue ſtain on the ſkin and adjoining wool: from this furrow, ſimilar ones muſt be drawn down the ſhoulders and thighs to the legs, as far as they are woolly; and, if the animal is much infected, two more ſhould be drawn along each ſide, parallel to that on the back; and one down each ſide, between the fore and hind legs *.

Immediately after being dreſſed, it is uſual to turn the ſheep among other ſtock, without any fear of the infection being communicated; and there is ſcarce an inſtance of a ſheep ſuffering any injury from the application. In a few days the

* Some of our graſiers begin to uſe it, by rubbing it into the naked part of the thigh and fore-leg; a practice much leſs troubleſome, but which requires much more judgement than the above.

blotches

blotches dry up, the itching ceafes, and the animal is completely cured; it is generally, however, thought proper not to delay the operation beyond Michaelmas.

The *hippobofca ovina*, called in Lincolnfhire *fheep-fagg*, an animal well known to all fhepherds, which lives among the wool and is hurtful to the thriving of fheep, both by the pain its bite occafions, and the blood it fucks, is radically deftroyed by this application; and the wool is not at all injured. Our wool-buyers purchafe the fleeces on which the ftain of the ointment is vifible rather in preference to others, from an opinion that the ufe of it having preferved the animal from being vexed either with the fcab or faggs, the wool is lefs liable to the defects of joints or knots; a fault obferved to proceed from every fudden ftop in the thriving of the animal, either from want of food, or from difeafe.

This mode of curing was brought into that part of Lincolnfhire where my property is fituated, about twelve years ago, by Mr. Stephenfon, of

Mareham, and is now ſo generally received, that the ſcab, which uſed to be the terror of the farmers, and which frequently deterred the more careful of them from taking the advantage of paſturing their ſheep in the fertile and extenſive commons with which their diſtrict abounds, is no longer regarded with any apprehenſion; by far the moſt of them have their flock anointed in autumn, when they return from the common, whether they ſhew any ſymptons of the ſcab, or not; and, having done ſo, conclude them ſafe for ſome time from either giving or receiving infection. There are people who employ themſelves in the buſineſs, and contract to anoint our large ſheep at five ſhillings a ſcore, inſuring for that price the ſucceſs of the operation; that is, agreeing, in caſe many of the ſheep break out afreſh, to repeat the operation *gratis*, even ſome months afterwards.

I beg to have it underſtood that, in communicating this information to the ſociety, I do not offer myſelf as a candidate for the medal propoſed by them as a reward: having been neither the diſcoverer nor the introducer of the remedy, I

can

can lay no claim to it. Reſpect to the patriotic views which have ever guided their conduct, and the hope of being uſeful to the breeders of ſheep, are the motives which have induced me to lay this paper before them.

XVIII. An Account of ſome Experiments on Wheel-Carriages; by Richard Lovell Edgeworth, Esq. M. R. I. A. and F. R. S.

WITH A PLATE.

From the Transactions of the Royal Irish Academy.

I WAS preſent, in 1773, at a ſet of experiments that were tried in London, to determine the relative advantage of high and low wheels for carriages. Diſputes had ariſen upon this ſubject between mechanics of no ſmall eminence; and to determine

determine them an apparatus was provided, consisting of a very long and smooth table, upon which the carriages to be compared were to be drawn by a string and a descending weight. The carriages were constructed by some of the best workmen in London; the strings were made of plaited silk, of small diameters, passing over a pulley nicely turned, and mounted in such a manner as to have scarcely any friction. The experiments, however, were undecisive, each party claiming their evidence in favour of their own opinion. Very little difference was perceptible between the carriages, when they ran upon the smooth table; and, when they were drawn over obstacles, sometimes the high and at other times the low wheels had the advantage, according to the different heights and shapes of the obstacles. It appears, upon a first view, that the force which drew these carriages was employed only in overcoming the friction of the axle-tree, or in lifting the weight over the obstacles; but I suspected at the time, and have been since convinced, that an obstruction of another sort existed, which was more considerable than either of those which I have mentioned,

and

and which has not, to my knowledge, been taken notice of by any writer upon mechanics.

The load upon a carriage, in paſſing over an obſtacle, reſiſts the power which draws it, not only by its weight, but by its *vis inertiæ*. After a carriage has been once ſet in motion upon a ſmooth road with any given velocity, its motion, ſo long as that velocity is continued, is neither retarded nor promoted by its *vis inertiæ*; but, whenever it paſſes over any height, not only the weight of the carriage muſt be lifted up, but the *vis inertiæ* of that weight muſt be overcome in a new direction; and as much velocity muſt be communicated to it, in that new direction, as will enable it to riſe to the height of the obſtacle whilſt it paſſes over its baſe. When an obſtacle is of ſuch a ſize and ſhape that a wheel of ſix feet diameter muſt ſtrike the top of it at once, and not roll from the bottom upwards, and when its ſhape will permit a ſmaller wheel to touch it during its whole aſcent, as there is more time allowed for overcoming the *vis inertiæ* of its weight in the latter caſe than in the former, the ſmaller wheel may be

drawn

drawn forwards by a lefs power than the larger, notwithftanding the advantage of a lever, which is in favour of the larger wheel.

To determine thefe circumftances by experiment, it was neceffary to conftruct an apparatus different from that which I have defcribed. I at firft made ufe of an inclined plane, of five or fix feet long, and one foot high, placed upon a fmooth horizontal floor. The diftance to which the carriage was driven upon the floor, by the velocity which it acquired in its defcent down this inclined plane, I affumed as the meafure of its acquired force; and the refiftance of any obftacle, which I placed in its way, I determined by the diminution of this diftance. But, though I was well fatisfied with the accuracy of this mode of trial, I conftructed another that may appear to others lefs liable to objection.

I fcrewed a circle of iron, three feet three inches diameter, upon a folid floor *; in the centre of this circle I erected an upright axis, or roller, upon two

* This apparatus is reprefented in Plate VIII.

pivots,

pivots, one reſting in a ſocket of braſs upon the floor, the other in a bridge which was raiſed acroſs the machine. This axis or roller had a ſmall ſilk cord wound round its circumference, which, paſſing into an adjoining ſtaircaſe, had a ſcale and weights tied to it, which turned the roller with the required velocity. From the roller a horizontal arm of wood extended to the circumference of this iron circle, and to its extremity was faſtened a piece of ſteel in the form of an axle-tree of a carriage, and upon this was placed a wheel, which by theſe means was carried round upon the iron circle, as the ſtone of a tanner's bark-mill moves round the trough which belongs to it. This arm was permitted to move up and down by means of a hinge, ſo as to let the wheel riſe over any obſtacle which was placed in its way. Beſides this, another arm was placed above that which carried the wheel, at the extremity of which was faſtened a piece of tin, forming a vane, which, by its reſiſtance to the air, regulated the motion of the machine. The roller was now made to turn, by putting weights into the ſcale, and it was let to revolve until its motion became uniform. After eight or ten turns it re-

 volved

volved with an equable velocity, and during every ſet of experiments the ſame velocity was preſerved; and whatever reſiſtance the carriage was expoſed to was overcome by the addition of weight. The additional weight became therefore, in all caſes, the meaſure of the additional reſiſtance, and determined, with the greateſt accuracy, the reſult of every experiment I wiſhed to try.

Having found that nearly five pounds and a half was ſufficient to give the wheel, when loaded ſo as to weigh about four pounds, a velocity of nearly ten feet in a ſecond, I placed an obſtacle of a quarter of an inch high upon the plane, and it required no leſs than ſix pounds and a half to overcome its reſiſtance. Two ſuch obſtacles required fourteen pounds and a half. Two obſtacles of the ſame height, but of different ſhape, each making an inclined plane of three quarters of an inch long, and a quarter of an inch high, were ſubſtituted in the place of the former, and it required but two pounds to overcome their reſiſtance. The difference, therefore, between two and fourteen muſt be attributed to *vis inertiæ*: for,

the

the velocities of the carriage and the heights of the obſtacles remaining the ſame, the only difference that exiſts is, that in one caſe the wheel has much more time to ſurmount the obſtacle than in the other, and conſequently has much leſs *vis inertiæ* to overcome.

From this conſideration it appears, that whatever permits the load to riſe gradually over an obſtacle, without obſtructing the velocity of the carriage, will tend to facilitate its draught; and the application of ſprings has this effect to a very conſiderable degree; the ſame weight of four pounds being drawn over the ſame obſtacles, (when ſprings were put between the load and the carriage,) by four pounds inſtead of fourteen. This remarkable difference points out the great advantage of ſprings in rough roads; an advantage which might be obtained for heavy waggons, as well as for other carriages, by a judicious application of the ſame means.

It has but ſeldom happened that the modeſty of theory has promiſed leſs than what has been veri-

fied by experiment; but it appears, from the Memoirs of the French Academy, that the idea of applying ſprings to carriages had occurred to M. Thomas, in the year 1703, who has given a drawing of a carriage, conſtructed upon this principle, many years before it was attempted to be put into execution. So little hopes had he entertained of ſucceſs, that he expreſsly mentions it as a theory which could not be reduced to practice; he had, however, no notion of applying ſprings to facilitate the draught, but merely for the convenience of the rider; and I apprehend that it is not at preſent commonly imagined that ſprings are advantageous for this purpoſe, nor would it at firſt ſight appear credible, that upon a rough paved road, ſuch as is common in Cheſhire, and other parts of England, a pair of horſes could draw a carriage mounted upon ſprings with greater eaſe and expedition than four could draw the ſame carriage, if the ſprings and braces were removed, and the carriage bolted faſt down to the perch. I tried ſome other experiments, with the ſame apparatus, to compare long and ſhort, high and low carriages. I have loſt the particular reſults of each

each experiment; but I am well aſſured that the preference, which has lately been given in England to high carriages, is ill-founded; that, upon ſmooth roads, the height of the carriage is a matter of indifference as to the draught, and that in rough roads it is conſiderably diſadvantageous; that the length of carriages, if their weight be not increaſed, is alſo a matter of indifference, except in very uneven roads, and where there are deep ruts; in the former, long carriages are preferable; in the latter, ſhort ones.

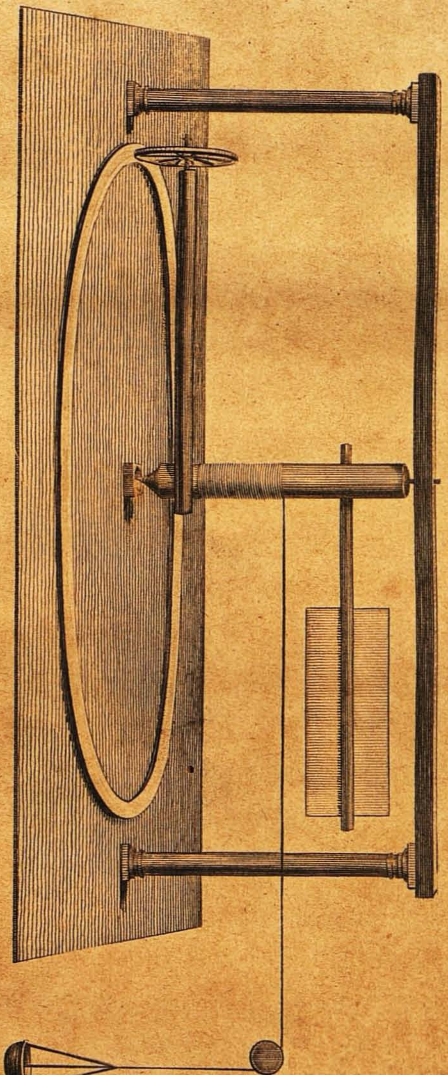
I ſubjoin a drawing of the apparatus, which I made uſe of in theſe experiments, (ſee Plate VIII.) and a table of the experiments; from which the mechanic may draw many uſeful obſervations, and which may ſupply the mathematician with many curious and elegant ſubjects of inveſtigation.

TABLE.

T A B L E.

The Weight of the Load 3lb. The Weight of the Load, Wheel, and Carriage, &c. 4lb. The Scale and Weight defcended fix Inches and two-tenths every Revolution of the Roller. The Diameter of the Wheel was two Inches nine-tenths; and the Circumference of the Circle upon which the Wheel ran was ten Feet three Inches and a quarter.

	Experiments.	Turns	Time Seconds	Weight lb.	Weight oz.		Obfervations.	lb.	oz.
1	A vane of tin, 11 inches long and $5\frac{1}{4}$ broad, faftened to an arm projecting from the roller, to regulate the motion of the machine by its refiftance againft the air; the extremity of the vane 21 inches from the centre of the roller, made — —	20	2	4	10	1	The refiftance of the air againft the vane, and againft all the moving parts of the machine, was equal to — — This weight muft therefore be deducted from the weights ufed in the fubfequent experiments.	4	10
2	The fame as No. 1. with the wheel running upon the iron circle — —	20	20	5	10	2	4lb. 10oz. being deducted for the refiftance of the air from 5lb. 10oz. the remainder was the refiftance occafioned by the motion of the wheel on the fmooth board — —	1	0
3	The fame as No. 2. but with an obftacle of $\frac{1}{4}$ inch high, placed on the road —	20	20	12	0	3	The refiftance of an obftacle $\frac{1}{4}$ inch high	6	6
4	The fame as No. 2. but with two obftacles	20	20	20	0	4	The refiftance of two obftacles of $\frac{1}{4}$ inch high	14	6
5	Do. with two inclined planes $\frac{1}{4}$ inch high, $\frac{1}{4}$ inch long, inftead of the obftacles	20	20	7	8	5	The refiftance of inclined planes, inftead of abrupt obftacles — —	1	14
6	Springs placed between the weight and the wheel, two obftacles $\frac{1}{4}$ inch high, placed on the road — —	20	20	9	8	6	The refiftance of two obftacles $\frac{1}{4}$ inch high, when fprings were ufed, only — —	3	14
7	Same as No. 1, with half the velocity	10	20	1	6	7	Refiftance of the air to half the former velocity	1	[illegible]
8	Same as No. 4, with half the velocity	10	20	7	8	8	Refiftance of two obftacles, with half the former velocity — — —	6	2
9	Same as No. 6, with half the velocity —	10	20	3	8	9	Refiftance of ditto with fprings —	2	2



XIX. Obſervations on the Magnetic Fluid; by Captain O'BRIEN DRURY, of the Royal Navy.

From the TRANSACTIONS of the ROYAL IRISH ACADEMY.

THE magnetic fluid and its phenomena are not leſs ſingular than obſcure, and have too long engaged the attention of philoſophers for me to offer an hypotheſis on the ſubject. I mean only to ſpeak to a matter of fact, which I am led to believe may be ſerviceable to navigation, eſpecially ſhould the variation of the compaſs ever be made uſe of as a method for aſcertaining the longitude.

It is not neceſſary to enter into a detail of experiments, to prove the exiſtence of the magnetic fluid, which circulates continually around and through

through a magnet, as it is fully demonſtrated by the arrangements of iron filings thrown on glaſs, placed over a magnet.

Experience ſhews us, that the needle of a compaſs, as well as all other magnets, whether artificial or real, perpetually loſes ſomething of its magnetic powers, which often produces a difference exceeding a point; and I am well convinced that the great errors in ſhip-reckonings proceed more frequently from the incorrectneſs of the compaſs than from any other cauſe.

Steel cannot be too highly tempered for the needle of a ſea compaſs, as the more it is hardened the more permanent is the magnetiſm it receives; but, to preſerve the magnetiſm, and conſequently the polarity of the needle, I recommend to have the needle caſed with thin, well-poliſhed, ſoft iron; or elſe to have it armed at the poles with a bit of ſoft iron.

I have found, from many experiments, that the caſed needle preſerved its magnetiſm in a much

more

more perfect degree than the needle not cafed; and I have fometimes thought that the magnetic power of the cafed needle had increafed, while the magnetic power of the uncafed and unarmed needle always lofes of its polarity.

Some time ago I placed a cafed needle, an armed needle, and one without either cafe or armour, in a room, for three months; each having at that time precifely the fame direction, and nearly the fame degree of force. At the expiration of the three months, I found that the cafed needle and the armed needle had not in the leaft changed their direction; but the other had changed two degrees, and had loft very confiderable of its magnetic power. If there was any change in either of the other needles, it was too inconfiderable to be perceived.

These obfervations appear to me to be new, and may tend to great improvement in our fea-compafs. They are fubmitted to the confideration of philofophers.

XX. An Improvement on Metallic Conductors or Lightning Rods; by ROBERT PATTERSON, of Philadelphia.

From the TRANSACTIONS of the AMERICAN PHILOSOPHICAL SOCIETY.

The Magellanic Gold Medal was given to Mr. PATTERSON, for this Improvement.

FROM the inſtances which now and then occur of houſes being ſtruck with lightning, that are furniſhed with metallic conductors, and the frequent inſtances of theſe conductors having their tops melted off by a ſtroke of lightning, it appears that this admirable contrivance for guarding houſes againſt the dangerous effects of lightning is, in ſome degree, ſtill imperfect. Some improvement

provement ſeems yet to be wanting at both extremities of the rod; at the upper extremity, to ſecure it againſt the accident of being melted, which renders it afterwards unfit to anſwer its original intention, viz. drawing off the electric fluid, or lightning, from the paſſing cloud, in a ſilent, imperceptible, manner; for, it is only *pointed* conductors that poſſeſs this property; and at the lower extremity, to afford a more ready paſſage for the fluid into the ſurrounding earth.

The firſt of theſe intentions would, I am perſuaded, be effectually anſwered, by inſerting in the top of the rod a piece of black lead, of about two inches long, taken out of a good pencil, and terminating in a fine point, projecting but a very little above the end of its metallic ſocket; ſo that, if the black-lead point ſhould happen to be broken off by any accident, (of which, however, I think there can be but little danger,) ſtill the point of the rod would be left ſharp enough to anſwer the purpoſe of a metallic conductor.

This ſubſtance is well known to be infuſible by the greateſt heat, and hence its uſe in making cru-

 cibles;

cibles; nor is it evaporable, as remarked by Cronſtedt, in his Mineralogy, (ſect. 231.) except in a ſlow calcining heat, to which it could never be expoſed on the top of a lightning rod.

At the ſame time its power, as a conductor of electricity, is perhaps equal, or but little inferior, to that of any of the metals. A line drawn on a piece of paper by a black-lead pencil will, as I have often experienced, conduct an electric exploſion, ſeemingly as well as a ſimilar line of gilding would do, and that without ever loſing its conducting power, which is not the caſe with gilding.

The ſecond intention is, to facilitate the eſcape of the electric fluid from the lower part of the rod into the ſurrounding earth. It is in many caſes impracticable, from the interruption of rocks, or other articles, to ſink the rod ſo deep as to reach moiſt earth, or any other ſubſtance which is a tolerably good conductor of electricity. Nor, even if this were practicable, would it I preſume be alone ſufficient to anſwer the deſired in-

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tention. Iron buried in the earth, and eſpecially in moiſt earth, will preſently contract a coat of ruſt, which will continually increaſe till the whole is converted into ruſt; but ruſt of iron, and indeed the calx of all metals is a *non-conductor*, or at moſt but a very imperfect conductor, of the electric fluid. Hence it is eaſy to ſee, that, in a few years after a lightning rod has been erected, that part of it which is under ground will contribute little or nothing towards the ſafety of the building. Beſides, the ſurface of this part of the rod is too ſmall to afford an eaſy and copious diſcharge of the electric fluid into the ſurrounding earth, when this is but an imperfect conductor.

As a remedy for theſe defects, I would propoſe that a part of the rod under ground be made of tin, or copper, which are far leſs liable to corroſion, or ruſt, by lying under ground, than iron. Or, which perhaps would anſwer the purpoſe better, let this part of the rod, of whatever metal it be made, be coated over with a thick cruſt of black lead, previouſly formed into the conſiſtence of paſte, by being pulverized and

mixed

mixed with melted ſulphur, (as in the manufacture of the ordinary kind of black-lead pencils,) and then applied to the rod while hot. By this means, the lower part of the rod would, I apprehend, retain its conducting power for ages, without any diminution.

In order to increaſe the ſurface of the lower part of the conductor, let a hole or pit of ſufficient extent be dug as deep as convenient, and into this pit let there be put a quantity of charcoal, round the lower extremity of the rod. Charcoal poſſeſſes two properties, which in a peculiar manner fit it for anſwering the purpoſe here in view. Firſt, it is a very good conductor of electricity; and ſecondly, it will undergo little or no change of property by lying ever ſo long in the earth. Thus might the ſurface of that part of the conductor in contact with the earth be increaſed, with little trouble or expence, to any extent at pleaſure; a circumſtance which every one acquainted with electrical experiments muſt acknowledge to be of great importance to the end here propoſed.

XXI.

XXI. An eaſy and expeditious Method of diſſipating the noxious Vapour commonly found in Wells, and other ſubterraneous Places; by EBENEZER ROBINSON, of Philadelphia.

From the TRANSACTIONS of the AMERICAN PHILOSOPHICAL SOCIETY.

AFTER various unſucceſsful trials, (a detail of which has been already communicated,) I was led to conſider how I could convey a large quantity of freſh air from the top to the bottom of the well, ſuppoſing that the foul would neceſſarily give way to the pure air. With this view I procured a pair of ſmith's bellows, fixed in a wooden frame, ſo as to work in the ſame manner as at the forge. This apparatus being placed at the edge of the well, one end of a leathern tube

(the hofe of a fire-engine) was clofely adapted to the nofe of the bellows, and the other end was thrown into the well, reaching within one foot of the bottom. At this time the well was fo infected, that a candle would not burn at a fhort diftance from the top; but, after blowing with my bellows only half an hour, the candle burned bright at the bottom; then, without farther difficulty, I proceeded in the work, and finifhed my well.

Wells are often made in a very flight manner, owing to the difficulty of working in them, and there have been feveral fatal inftances of the danger attending the workmen; but, by the above method, there is neither difficulty nor danger in completing the work with the utmoft folidity.

It is obvious, that in cleanfing vaults, and working in any other fubterraneous place, fubject to damps, as they are called, the fame method muft be attended with the fame beneficial effect.

XXII. Continuation of Mr. BERTHOLLET's Method of bleaching Cloths and Thread.

(FROM p. 69.)

IF we have good calx of manganeſe, formed in ſmall cryſtals, and containing but little extraneous matter, the proportions of the ſubſtances to be ſubmitted to diſtillation, which appeared to me the moſt convenient, are the following:

Six ounces of calx of manganeſe reduced to powder; one pound of common ſalt, alſo reduced to powder; twelve ounces of concentrated vitriolic acid, or oil of vitriol; from ten to twelve ounces of water.

If the calx of manganeſe contains earthy or any other metallic matter, we muſt increaſe the quantity thereof in proportion to its impurity. We

may diſcover, after the operation, whether a ſuffi-cient quantity has been employed therein; as there ought to remain a ſmall portion of it, which has not been decompoſed, and which therefore re-tains its black colour; by this obſervation we may regulate the proportions of it, which ought to be employed in ſucceeding operations.

When calcareous ſpar is mixed with the calx of manganeſe, (which is known by the efferveſcence which is produced as ſoon as a little vitriolic acid is poured thereon,) it is proper to waſh it, before the operation, with vitriolic acid diluted with wa-ter, to ſeparate from it the calcareous part, which would be troubleſome on account of the efferveſ-cence it would produce. After which the calx is to be dried *.

There ſhould be added more or leſs water, not only according to the degree of concentration of the vitriolic acid, but alſo according to the quan-

* It appeared to me that when the calx of manganeſe con-ained much azote, (phlogiſticated air,) it was by no means proper for making the oxygenated muriatic acid.

tity

tity of matter which is ſubmitted to diſtillation; if this quantity is conſiderable, the acid ſhould be more diluted than if it is ſmall. It would be more advantageous to make uſe of acid which has not been concentrated, as the operation of concentrating it adds to its coſt, and as we are then obliged to dilute it again with water; that is to ſay, provided the manufactory where it is made is in the neighbourhood; for, if the acid is to be carried to any conſiderable diſtance, it may be œconomical to concentrate it.

When the materials are prepared, we muſt carefully mix the calx of manganeſe with the common ſalt, and introduce the mixture into the diſtilling veſſel placed upon a ſand-bath: we muſt then pour upon it the vitriolic acid, previouſly diluted, (and of which the heat occaſioned by its mixture with water is diſſipated,) and immediately apply to the mouth of the matraſs the tube which is to conduct the gas into the intermediate veſſel. It muſt not be forgot, that in this operation the lutes require particular attention.

The ſize of the veſſels ſhould be ſuch, that the diſtilling matraſs may be about one third empty; and, for the quantity above mentioned, the tub ſhould hold one hundred quarts of water; there ſhould alſo be an empty ſpace of about ten quarts, in order that when the gas lodges itſelf in the cavities intended to receive it, the water may have a free ſpace to riſe in.

Before the commencement of the operation, the pneumatic tub muſt be filled with water. The mixture being made, the gas, which very ſoon begins to diſengage itſelf, drives out the atmoſpherical air which is in the apparatus; when it is judged that the atmoſpheric air has paſſed into the cavities, it is to be drawn off by means of a bent tube, which is to be introduced ſucceſſively under each cavity; to drive out the water which has entered into the tube, this laſt is to be forcibly blown into. The operation is then ſuffered to go on without fire until it is perceived that the bubbles come over but ſlowly: then a little fire is to be applied, which is not to be haſtily increaſed at the beginning, but may be gradually augmented, ſo

ſo that at the end of the operation the matter may be brought to a boiling ſtate. It is known to be nearly finiſhed when the tube by which the gas is diſengaged, and the intermediate veſſel, become hot. When the gas is diſengaged only in a ſmall quantity, the fire may be withdrawn; and, when the diſtilling veſſel retains but a gentle warmth, it is to be unluted, and warm water is to be poured upon the reſidue, that it may remain in ſolution, and thereby be more eaſily poured out; this reſidue is then to be thrown into a large veſſel, intended to collect it for the uſe which I ſhall hereafter point out.

The operation is longer or ſhorter, according to the quantity of materials; with that above mentioned, it ſhould laſt five or ſix hours; it is proper not to haſten it, that a larger quantity of gas may be drawn off. A ſingle perſon is able to manage ſeveral diſtillations at the ſame time, to each of which may be given much larger quantities of materials than thoſe which have been pointed out.

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The intermediate veſſel by degrees becomes filled with a liquor which is pure, though weak, muriatic acid; nevertheleſs, we may perform the operation ſeveral times without extracting it; but, when it is ſuppoſed that there is not ſufficient empty ſpace, this acid is to be drawn off by means of a ſyphon, and, when we have collected a ſufficient quantity of it, it may be ſubſtituted for the mixture of vitriolic acid and common ſalt in the operation we have deſcribed, if we have no other uſe to make of it. That there may paſs but a ſmall quantity of muriatic acid, not oxygenated, the firſt tube ought to form a right angle, or even an obtuſe one, with the body matraſs.

During the operation, the agitator muſt be from time to time put in motion, to favour the abſorption of the gas by the water; when it is finiſhed, the liquor is of a proper ſtrength to uſe in bleaching; or, we may put a leſs quantity of water in the tub, and then dilute the liquor according to the proportion already mentioned.

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In this ſtate of concentration, although the liquor has a pretty ſtrong odour, it nevertheleſs is not hurtful, nor even very unpleaſant, to thoſe who uſe it; it is, however, proper to conduct it into the troughs where the cloths are placed by means of wooden canals, which are to be connected with the fauſet or tube which is at the lower part of the tub.

It is right to draw off the liquor from the tub as faſt as it is prepared, as it has an action upon the wood, by which not only the liquor is weakened, but the deſtruction of the tub is alſo haſtened; when it meets with cloth in the trough, it is thereby ſo ſpeedily weakened, that it does not any longer act ſenſibly upon the wood.

It is neceſſary to prepare the cloth by leaving it to ſoak for twenty-four hours in water, or, which is better, in ſome old ley. Afterwards it ſhould be ſubmitted to the action of one or two good leys, becauſe all the colouring part which may be extracted by the leys would elſe, without any advantage, conſume a part of that liquor which it is

important

important to be as ſparing of as poſſible. After this the cloth is to be carefully waſhed, then it is to be placed in the troughs, without any part being preſſed or confined, in ſuch a manner that it may be thoroughly impregnated with the liquor which is to run thereon. The troughs, as well as the tub, ought to be conſtructed without iron; for that metal, being ruſted by the oxygenated muriatic acid, would produce iron moulds, which could not be taken out but by means of ſalt of ſorrel.

The firſt immerſion ought to be longer than the others; it may be continued for three hours, after which the cloth is to be taken out: it is to be again ſubmitted to the action of ley, and then placed in a trough, that freſh liquor may be poured thereon; it is ſufficient that this immerſion, and the following ones, continue half an hour. When the cloth is taken from the trough, the liquor is to be wrung out, it is to be again ſubmitted to the ley, and afterwards to freſh immerſions. The ſame liquor may ſerve until its

ſtrength is exhauſted; when it is much weakened, there may be ſome freſh liquor added to it.

When the cloth appears white, except ſome black threads and the liſts, it is to be impregnated with black ſoap, and then ſtrongly rubbed; after which it is to be ſubmitted to the laſt ley, and the laſt immerſion.

We cannot determine what number of leys and immerſions may be neceſſary, becauſe it varies according to the nature of the cloth; nevertheleſs, the limits of this number are between four and eight, for linen or hempen cloths.

I am not able to point out the beſt manner of preparing the leys; this art, uſeful as it is, being exerciſed according to cuſtoms and practices which are varied in different places. I ſhall only ſay, that it appears to me uſeful to render the alkali cauſtic, by mixing with it one third of quicklime; but then we muſt take care that the ley is ſtrained through linen, that the calcareous earth may not mix itſelf with the cloth; for the mole-

cules, which might be interpoſed, would be apt to injure it by their hardneſs; in this manner the ley is rendered more active, and there is no neceſſity for ſo large a quantity of alkali; nevertheleſs, if it is not too ſtrong the cloth is not injured, notwithſtanding the contrary prejudice, which is very general. I have alſo remarked that it is uſeleſs, and even hurtful, that the action of the leys ſhould be long continued; but it is neceſſary that they ſhould be very warm, and ſufficiently ſtrong, otherwiſe the cloths bleached by the oxygenated muriatic acid become of a reddiſh colour when they are ſubmitted to freſh leys. This accident really took place in the trials of which I am now going to ſpeak.

TO BE CONTINUED IN OUR NEXT.

XXIII.

XXIII. Conclusion of M. GROSSART's Method of making Instruments of Elastic Gum.

(FROM p. 72.)

THE difficulty of procuring the juice unaltered in this country is evident; and the distance of the places where the trees grow; the necessity of having agents there to see the necessary articles properly executed; the length of time we should be obliged to wait before we could receive what was ordered; all concur to render it an object of desire both to philosophers and artists, that they might be able to use the bottles of caoutchouc, which we have here in abundance, so as to make from them the various instruments they may have occasion for. Many persons have employed themselves in this research, but I know not that as yet any one has succeeded.

It was ſoon diſcovered, that it was not poſſible to employ liquefaction by means of heat; caoutchouc indeed melts as eaſily as other reſins, but when cooled it remains liquid and adheſive. Alcohol, or ſpirit of wine, the uſual ſolvents of reſinous ſubſtances, did not act upon it, nor was it diſſolved in water, as gums are. It was then tried to diſſolve it in drying oils, and it was found that by the aid of heat the caoutchouc was diſſolved, and formed an excellent varniſh, ſupple, impervious to air or water, and reſiſting a long time the action of acids. With this varniſh Meſſrs. Charles and Robert covered their balloons; and an ingenious artiſt, M. Bernard, and afterwards the brothers Durand, made with it ſeveral inſtruments uſeful in ſurgery. Their catheters are much uſed, and are known by the name of catheters of elaſtic gum; they are flexible, and have a ſufficient elaſticity; they are however nothing but taffety, covered with a ſolution of elaſtic gum in ſome kind of drying oil. This covering after ſome time cracks, and falls off in ſcales, and they then become unſerviceable. They have not the property of lengthening, and again recovering their former

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dimenſions, like a tube of caoutchouc: perhaps there may be caſes where, for this very reaſon, theſe inſtruments may be preferable to thoſe which might be made of the pure elaſtic gum.

Macquer alſo made ſome reſearches on this ſubject, and to him I believe it was firſt known that ether diſſolves caoutchouc without altering its nature. He propoſed to apply the ſolution, layer upon layer, on a mould, and let the ether evaporate; this proceſs was however too long, and too expenſive, to be of much uſe: moreover, the very fact of the diſſolution has been conteſted by many chemiſts, who have not ſucceeded in repeating the experiments of Macquer; reſpecting which there is not at preſent any manner of doubt, although it is not yet determined whence aroſe the different reſults in the experiments of thoſe who were occupied on this ſubject. A well known fact, the publication of which we owe to Mr. Cavallo, may perhaps explain the matter. Ether, which before being waſhed only makes the caoutchouc ſwell, diſſolves it with eaſe after it has been waſhed with a large quantity of water. It neceſ-

ſarily loſes, by this operation, that acid, of which indications are frequently found, and ſaturates itſelf with water. Be that as it may, it is eaſy at preſent to obtain, by means of this proceſs, a ſolution which, after the evaporation of the ſolvent, is pure elaſtic gum: yet this mode of making inſtruments, though poſſible, is nearly impracticable, as it is not only too expenſive, from the loſs of the ether which evaporates, and of that which is taken up by the water; but it is alſo very inconvenient to manage the concentrated ſolution of caoutchouc, becauſe it adheres to every thing that it touches, and bubbles of air are apt to be retained in the pellicles of elaſtic gum, which are formed by the evaporation of the ether.

Several eſſential oils, as thoſe of turpentine and lavender, act upon the caoutchouc, even when cold; yet in making uſe of them, in the manner already explained, we ſhall ſucceed ſtill leſs than with ether, either in obtaining pure elaſtic gum, or in forming inſtruments. M. Fourcroy, in a memoir read in December, 1790, at the Royal Society of Agriculture, in which he mentions all

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the facts known in regard to caoutchouc, and adds many interesting experiments, has expressed his wishes, and given his idea of the manner by which the juice of the caoutchouc may be brought to us without alteration. The desire of a philosopher so worthy of praise, and the little probability there exists of seeing his wishes fulfilled, made me recur to some ideas I had formed upon the subject; and I have succeeded in making, with the bottles of elastic gum, the tubes which are now presented to you. My work is indeed very imperfect; yet, being certain that my ideas, by being made known, will sooner acquire in the hands of artists the perfection of which they are susceptible, I shall not keep back, from selfish motives, the knowledge of a process which may be useful in many arts.

The following is the path I have pursued, and the methods I have employed: it may be easy to substitute better, but those of which I am about to give an account may certainly be of some advantage, inasmuch as they may prevent others who

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may employ themſelves in ſuch reſearches from making uſeleſs trials.

It appeared, even in my firſt experiments, that I was attempting too much, and giving myſelf uſeleſs trouble, in ſearching for a manner of completely diſſolving the elaſtic gum, ſo that it might be again made up in new forms. I then thought that it would be eaſier to find out a method, as it were, of ſoldering it, and of not acting upon it more than might be neceſſary to cauſe its ſoftened parts to reunite. Experience has ſhewn me that a ſtrong preſſure made upon two pieces of caoutchouc, (when brought to that ſtate of ſoftneſs,) and continued until they are entirely dry, cauſed them to contract ſo ſtrong an adheſion, that the piece, being pulled out till it broke, often broke, not at the united part, but by the ſide of it.

By means of ether I immediately ſucceeded in making theſe tubes; the method which appears to me to ſucceed the beſt is, to cut a bottle circularly in a ſpiral ſlip of a few lines in breadth. It

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is very eaſy to cut a bottle in ſuch a manner as to form a ſingle long ſlip, and thus unneceſſary joinings are avoided.

The whole ſlip is to be plunged into ether, until it is ſufficiently ſoftened, which comes to paſs ſooner or later, according to the quality of the vitriolic ether that is employed. Half an hour frequently ſuffices; but I have already obſerved that there is a great diverſity in the manner in which different ſorts of vitriolic ether act, and of which the cauſe is not yet, ſo far as I know, determined.

The ſlip being taken out, one of the extremities is to be taken hold of and rolled, firſt upon itſelf at the bottom of the tube, preſſing it; then the rolling is to be continued, mounting ſpirally along the mould, and taking care to lay over and compreſs with the hand every edge, one againſt the other, ſo that there may not be any vacant ſpace, and that all the edges may join exactly. The whole is then to be bound hard with a tape of an inch in width, taking care to turn it the

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ſame way with the ſlip of elaſtic gum. The tape is to be tied up with packthread, ſo that, by every turn of the packthread joining another, an equal preſſure is given to every part: it is then left to dry, and the tube is made.

The bandage is to be taken off with great care, that none of the outward ſurfaces, which may have been lodged within the hollows of the tape, (of which the caoutchouc takes the exact impreſſion,) may be pulled away. I adviſe the application of a tape before the packthread, becauſe, eſpecially in the thinner tubes, we ſhould run the riſk of cutting the caoutchouc, if the packthread were applied immediately upon it.

It is eaſy to take off the tube of elaſtic gum which has been formed upon a ſolid mould of one piece; if the mould be made rather conic, it may be made to ſlide off by the ſmaller end; at the worſt, it is eaſily accompliſhed by plunging it into hot water; for, it is ſoftened by the heat, and is diſtended; without this precaution it would be ſometimes difficult to draw it off when dry,

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becaufe, having been applied upon the mould whilft it had its volume augmented by the interpofition of the ether, the parts of the caoutchouc are drawn nearer each other by the evaporation of the interpofed bodies.

The great affinity between thefe two bodies is feen by the length of time that the odour of the other remains, notwithftanding the great volatility of the latter, and that the apparent drynefs of the tube feems to fhew that there is none remaining; neverthelefs, after a certain time, the odour difappears entirely. One of thofe tubes which are now before you, and which was made with ether, after the method here defcribed, does not retain the leaft trace of the folvent. It is needlefs to fay, that it is eafy to make tubes as thin, or as thick, as may be judged proper.

Although the procefs that I am now defcribing is but very little expenfive, yet I have tried to employ other folvents in lieu of ether, becaufe it is not to be had in every place, and requires particular care in its prefervation. I have em-

ployed, with fome fuccefs, the effential oils of lavender, and of turpentine ; both of them fpeedily dilate the caoutchouc, and are of no great price. The difagreeable fmell of the oil of turpentine becomes, perhaps, in procefs of time, lefs difagreeable than that of lavender. This laft is dearer, but the difference is not fo great as it appears at firft, for we may make fome advantage of the oil of lavender that is employed, by the following operation ; upon plunging into alcohol the elaftic tube prepared with the oil of lavender, the alcohol charges itfelf with the oil, and forms a very good lavender-water ; the fame as would be made by an immediate mixture of oil of lavender with fpirit of wine. Immerfion in this liquor alfo ferves to haften the drying of the caoutchouc inftruments, thus made by means of effential oils. I have made tubes with the oils of turpentine and of lavender ; both are much flower in evaporating than ether. The oil of turpentine particularly appeared to me always to have a kind of ftickinefs, and I know not as yet that we have any means whereby to get fpeedily rid of its fmell.

Neverthelefs

Neverthelefs there is a folvent which has not that inconvenience; it is cheaper, and may eafily be procured by every one; this folvent is *water*. I conceive it will appear ftrange to mention water as a folvent of elaftic gum, that liquid having been always fuppofed to have no action upon it. I myfelf refifted the idea; but, reflecting that ether by being faturated with water is the better enabled to act on caoutchouc, and that this gum when plunged into boiling water becomes more tranfparent at the edges, I prefumed that this effect was not due fimply to the dilatation of its volume by the heat, I thought that, at that temperature, fome action might take place, and that a long-continued ebullition might produce more fenfible effects. I was not difappointed in my expectations, and one of thofe tubes was prepared without any other folvent than water and heat. I proceeded in the fame manner as with ether; the elaftic gum dilates but very little in boiling water, it becomes whitifh, but recovers its colour again by drying it in the air and light. It is fufficiently prepared for ufe when it has been a quarter of an hour in boiling water; by this time its edges

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are ſometimes tranſparent. It is to be turned ſpirally round the mould, in the manner we deſcribed before, and replunged frequently into the boiling water, during the time that is employed in forming the tube, to the end that the edges may be diſpoſed to unite together. When the whole is bound with packthread, it is to be kept ſome hours in boiling water, after which it is to be dried, ſtill keeping on the binding.

If we wiſh to be more certain that the connection is perfect, the ſpiral may be doubled; but we muſt always avoid placing the exterior ſurfaces of the ſlips one upon the other, as thoſe ſurfaces are the parts which moſt reſiſt the action of ſolvents. This precaution is leſs neceſſary when ether is employed, on account of its great action upon the caoutchouc.

It might be feared, that the action of water upon caoutchouc would deprive us of the advantages which might otherwiſe be expected; but theſe fears will be removed if we conſider that the affinities differ according to the temperatures; that it

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is only at a very high temperature that water exercifes any fenfible action upon caoutchouc. I can affirm that at the hundred and twentieth degree of Reaumur's thermometer [302 of Fahrenheit] this affinity is not fuch as that the water can give a liquid form to caoutchouc; and it does not appear that we have any thing to fear in practice from a combination between thefe two bodies, which, though it really is a true folution, does not take place in any fenfible degree but at a high temperature. It is therefore, at prefent, eafy to make of caoutchouc whatever inftruments it may be advantageous to have of a flexible, fupple, and elaftic, fubftance, which is impermeable to water at the temperature of our atmofphere, and refifts the action of acids, as well as that of moft other folvents. As to the durability of thefe inftruments, few fubftances promife more than this, becaufe it may be foldered afrefh in a damaged part. Any woven fubftances may be covered with it, it is only required that the fubftance fhould be of a nature not to be acted upon, during the preparation, either by ether or by boiling water; for, thefe two agents are thofe

which appear to me to merit the preference. Artists will frequently find an advantage in employing ether, as it requires leſs time; ſo that a perſon may make, in a ſingle day, any tube he may have occaſion for. The expence of ether is very little, ſince it is needful only to diſpoſe the caoutchouc to adhere; and, being brought into that ſtate, the caoutchouc may be kept in a veſſel perfectly well cloſed. It would alſo diminiſh the expence of the ether if, inſtead of waſhing it with a large quantity of water, there ſhould be added to it only as much water as it can take up.

REPERTORY OF ARTS AND MANUFACTURES.

NUMBER III.

XXIV. Specification of the Patent granted to the Earl of DUNDONALD; for his Method of extracting or making Tar, Pitch, essential Oils, volatile Alkali, mineral Acids, Salts, and Cinders, from Pit-Coal.

Dated April 30, 1781.

The usual Term of fourteen Years was afterwards extended, by Act of Parliament, to twenty Years, from June 1, 1785.

TO all to whom these presents shall come, &c. Now KNOW YE, that, in compliance with the said proviso, I the said Archibald Earl of Dundonald do hereby declare, that the method I have

invented for the extracting of tar, pitch, essential oils, volatile alkali, mineral acids, and salts, and the making of cinders from pit coal, consists in admitting the external air to have a passage or passages through the vessels or buildings in which the coal, from which any of the above substances is to be distilled, is put, whether by itself or along with limestone, flints, iron ore, brick, or any other substance, by which means the said coals, after being kindled, are enabled by their own heat, and without the assistance of any other fire, to throw off in distillation of vapour, the tar, oil, alkalies, acids, and salts, they contain, into receivers or condensing vessels, communicating with the vessels or buildings containing the coals, and, at the same time, of roasting, calcining, or burning, any substances that may be mixed with them; it appears to me necessary, lest others encroach on my patent, to describe, as above, the principle upon which I act, in as few words as possible, and in such a manner as will admit of no ambiguity: Therefore, according to what is above set forth and declared, persons who shall extract tar, &c. from pit-coals in

in veſſels or buildings, (it matters not their ſhape or ſize,) whereby the coals are made to burn, or ignite, without flaming, by a regulated admiſſion of the external air through different apertures in the buildings, ſo as by their own heat to throw off the tar, oils, &c. that they may contain; perſons who do ſo, without my permiſſion, are deemed to encroach upon my patent; as the only method uſed or known, until my new diſcovery, was a diſtillation of coals in cloſe veſſels, where the admiſſion of the external air was prevented; and where other fuel or coals were required, beſides the coals contained in the cloſe veſſel, to produce the heat neceſſary to pervade the ſame, and to cauſe the coals contained therein to throw off the tar, oils, &c. that they contained. I do not think it any-ways of moment to ſubjoin any drawings of the buildings, or kilns, that may be uſed according to my new invention for the making of tar, &c. becauſe theſe buildings may be made either ſquare, circular, or oval, as fancy may direct, the art depending upon the management of the air admitted into the kilns, which can only be acquired by experience; and, as it is by no means

meant to keep the manufacture hid or concealed, those who want to see the practical part will have an opportunity so to do at the different places where the manufacture is to be carried on. Exclusive of the above invention, for which only the patent has been obtained, I promote the condensation of the less coercible part of the vapour that comes off in distillation, by commixing it with the steam of boiling water, and complete the condensation by the means of cold water, either in contact with the vapour, or applied externally to the vessels through which it passes; and, by an admission of the external air into the condensing vessels when needful, I also cause the vapour to pass through more condensing vessels than one, to separate, by that means, the different oils and substances, according to the different degrees of cold and moisture requisite to condense them; or occasionally I follow the usual and common modes in practice for condensing the vapours thrown off from any substances by the action of heat. In witness whereof, &c.

XXV.

XXV. Specification of the Patent granted to Mr. William Bell of Walſall, in the County of Stafford, Buckle-maker; for his new-invented Buckles or Shoe-faſtenings.

WITH THREE PLATES.

Dated May 17, 1794.

To all to whom theſe preſents ſhall come, &c. Now know ye, that, in compliance with the ſaid proviſo, I the ſaid William Bell do hereby particularly deſcribe the nature of my ſaid invention, and how the ſame is to be performed, as follows. I take any metal or metals, ſubſtance or ſubſtances ſimple or compounded, and ſufficiently hard, and capable of being bent, cut, caſt, or otherwiſe formed into a curve, and I form the ſame into thin plates, rims, or frames, of ſome ſhape proper to be placed conveniently on the upper part of the foot, and to conſtitute the ſkele-

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ton of a buckle; ſome examples of which plates, rims, or frames, are ſhewn at (a) in the annexed plans and ſections reſpectively, No. 1, 2, 3, 4, (Plate IX.) and 5 (Plate X.); repreſenting in various forms the underſide of the plate, rim, or frame, of my ſaid new-invented buckle or ſhoe-faſtening; in viewing which, for the preſent, you are not to conſider the parts marked d, b, and c, by addition of which to the plate, rim, or frame, the buckle or ſhoe-faſtening is to be completed, as mentioned below. Thus I ſolder, rivet, ſcrew, or otherwiſe affix, near to one of the extremities or ends of the plate, rim, or frame, (firſt) an immovable bar, ſtaple, or loop, as repreſented at (b) in the plans and ſections reſpectively No. 1 and 2; the faſtenings, *i. e.* the ſoldering, riveting, ſcrewing, &c. to be applied at the two ends of the ſaid bar, ſtaple, or loop, which is formed ſo as to leave a ſpace between the bar, ſtaple, or loop, and the underſide of the plate, rim, or frame; or, (ſecondly,) a roller turning upon an angle or pivots, as repreſented at (b) in the plan and ſection No. 3; or, (thirdly,) a loop movable upon a joint or joints, as repreſented at (b) in the plans

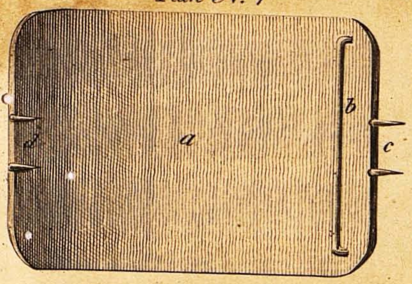
plans and fections refpectively No. 4 and 5. I cut out of the extremity, or end of the faid plate, rim, or frame, to which the bar, ftaple, loop, or roller, is affixed or to be affixed, as above defcribed, a fpike or fpikes having the points outwards, or reprefented at (c) in the plan or fection refpectively No. 1; or, I make fuch fpike or fpikes of feparate pieces of metals, hardened and tempered fteel being the beft for the purpofe, and then folder, rivet, or otherwife affix it near to the faid extremity of the plate, rim, or frame, as is reprefented at (c) in the plans and fections refpectively No. 2, 3, 4, and 5; or I cut this fpike or fpikes out of, or affix them to, or upon, the bar, ftaple, roller, or loop, as reprefented at (c) in the plans and fections refpectively No. 6, 7, and 8. (Plate X.) I alfo cut out of the oppofite extremity, or end of the fame plate, rim, or frame, a hook or hooks, catch or catches, pointing inwards, or towards the end of the buckle, as reprefented at (d) in the plan and fection refpectively No. 1; or I make thefe hooks or catches of a feparate piece, which I folder, fcrew, rivet, or otherwife affix, to the faid plate, rim, or frame, as reprefented

at

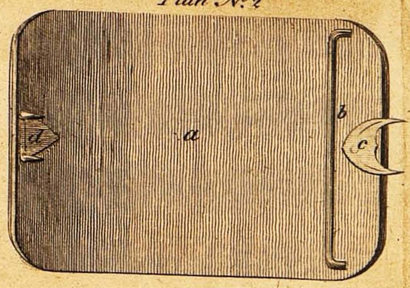
at (d) in the plans and fections refpectively No. 2, 3, 4, 5, 6, 7, and 8; which faid hooks or catches, being fharpened or pointed, ferve to anchor or faften the buckle, when drawn in the direction from d towards c. (See plate No. 1.) And, finally, I either ornament the oppofite or upper fide of the faid plate, rim, or frame itfelf, or I folder, rivet, fcrew, or otherwife affix upon it, any ornament or mounting that may be fuitable, or according to fancy or fafhion. To ufe this buckle or fhoe-faftening, I introduce the outfide ftrap of the fhoe, betwixt the bar, loop, or roller, and the plate, rim, or frame, of the buckle, as reprefented at (e) in the fection No. 9 (Plate XI.); I next lay the buckle in the pofition I wifh it upon the foot, and, by a flight preffure, I force the hooks (d) (fee fection No. 10, Plate XI.) into the infide ftrap of the fhoe; I then draw the outfide ftrap till I feel the fhoe fufficiently tightened, upon which I raife the end of the faid ftrap, and preffing it againft the fpikes (c) at the bar end, they penetrate into the ftrap, and thus fecure the buckle in its pofition. The novelty, or effential part, of my invention confifts in the bar, ftaple, roller,

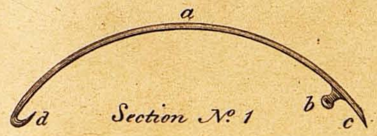
or,

Plan No. 1

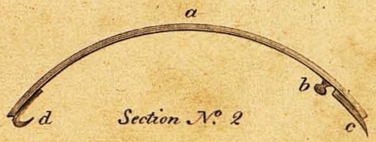


Plan No. 2



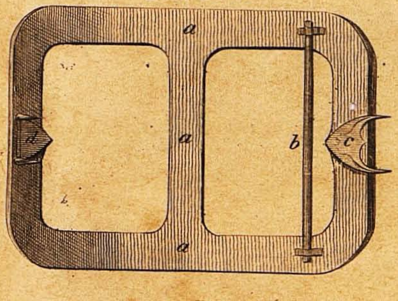


Section No. 1



Section No. 2

Plan No 3



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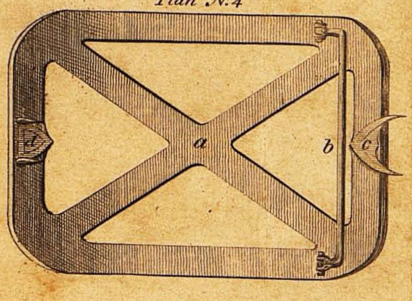
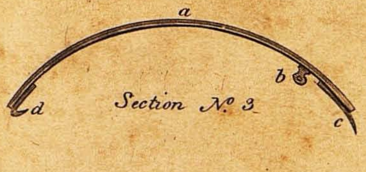
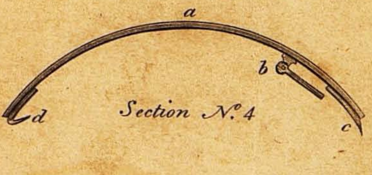


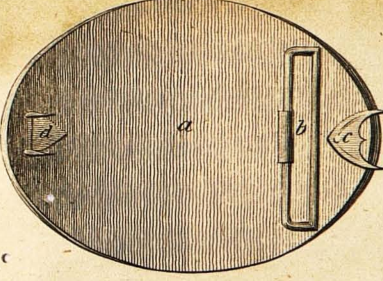


Section No. 3

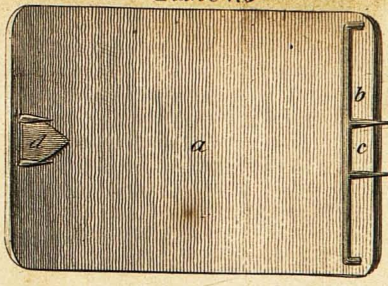


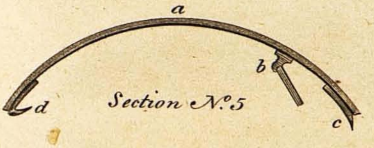
Section No. 4

Plan No. 5



Plan No. 6





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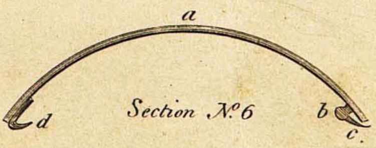
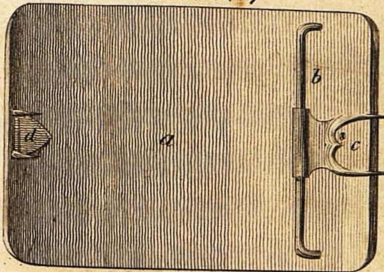
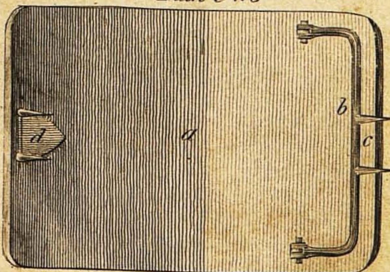


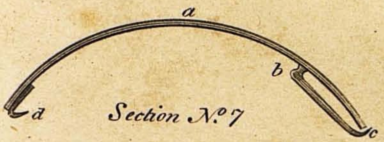
Section No. 6

Plan No. 7



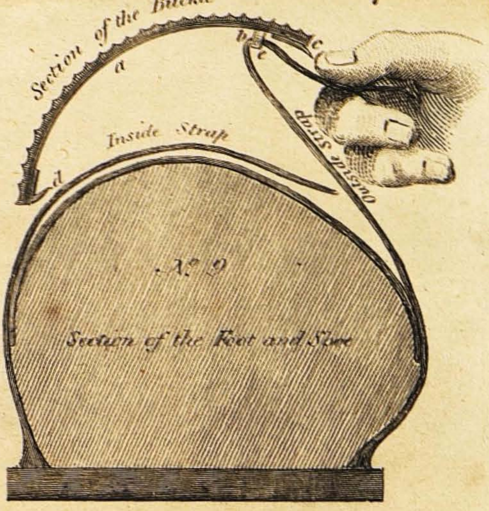
Plan No. 8

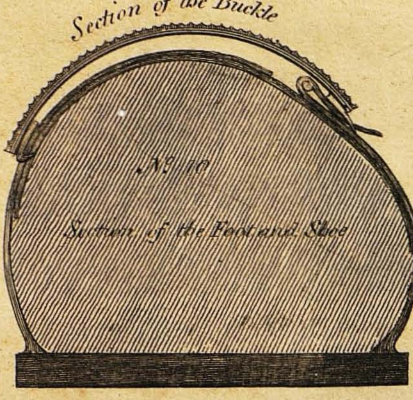




Section No. 7

Section No. 8


Section of the Buckle
a
b
c
e
d
Inside Strap
Outside Strap
No. 9
Section of the Foot and Shoe


Section of the Buckle
No. 10
Section of the Foot and Shoe

or loop (b), betwixt which, and the plate, rim, or frame, the ſtrap is drawn, and in the ſecuring the ſtrap in its place, by means of the ſpikes (c) above deſcribed. Theſe buckles or ſhoe-faſtenings are not confined to any particular form, material, thickneſs, or ſize, and may be covered with a fixed leather or ſtrap, as is uſual in other kinds of buckles or ſhoe-faſtenings. Any of the ſtrong metals, ſuch as iron, copper, braſs, tutenague, or ſilver, or their compounds with other metals, may be uſed for the plate, rim, or frame, or for the bar. The plate, rim, or frame, may alſo be made of horn, whalebone, tortoiſeſhell, wood, hardened leather, *papier maché*, or other ſubſtances poſſeſſing ſimilar qualities. In witneſs whereof, &c.

XXVI. Specification of the Patent granted to Mr. ROBERT STREET, of Providence-Row, in the Pariſh of Chriſtchurch, Surrey, Varniſh-maker; for his Invention to produce an inflammable Vapour Force, for communicating Motion to Engines, Pumps, and Machinery.

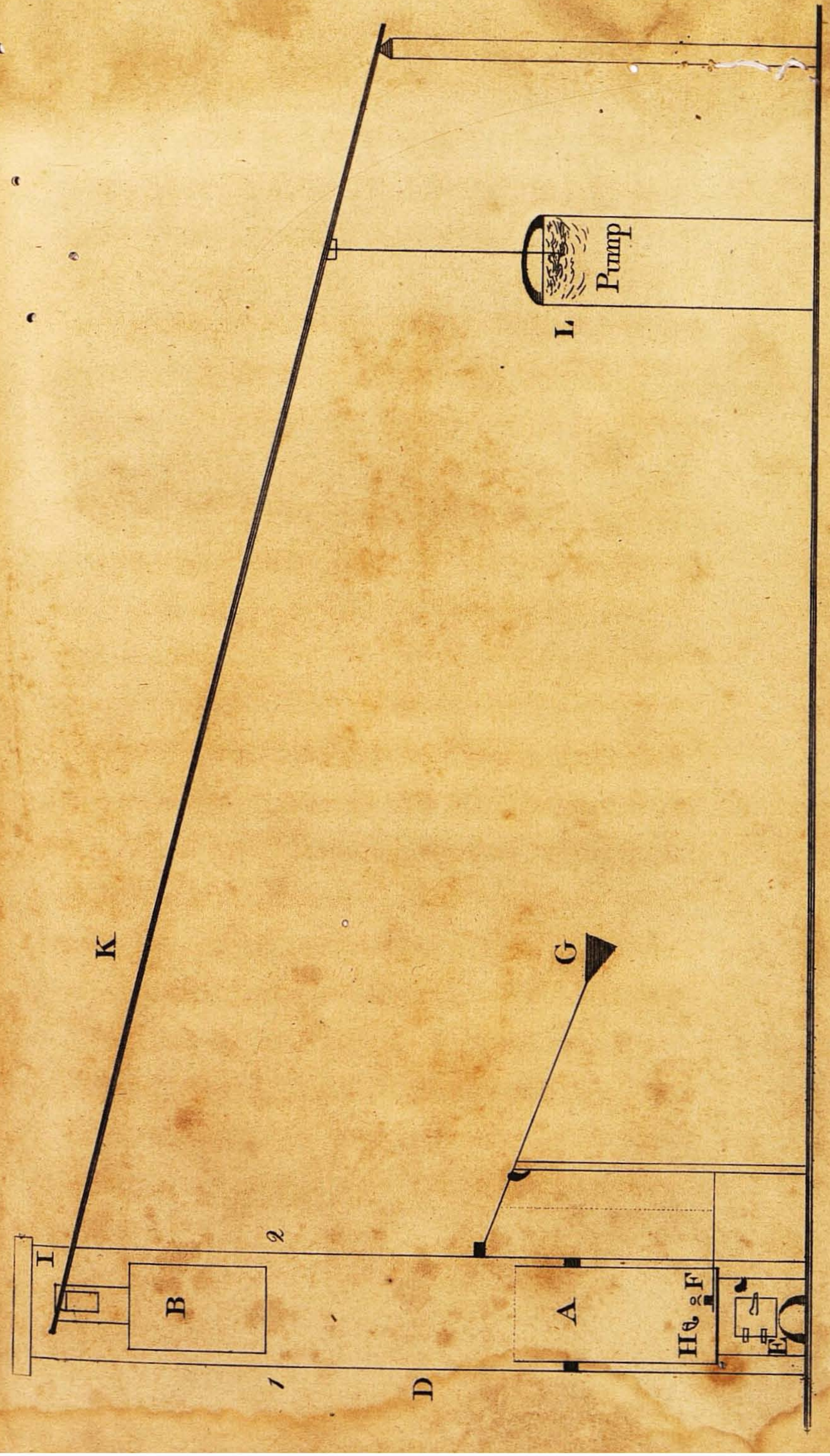
WITH A PLATE.

Dated May 2, 1794.

TO all to whom theſe preſents ſhall come, &c. NOW KNOW YE that, in compliance with the ſaid proviſo, I the ſaid Robert Street do hereby declare, that my ſaid invention, or method to produce an inflammable vapour force, by means of liquid air, fire, and flame, for communicating motion to engines, pumps, and machinery, is deſcribed, and is to be performed by a machine, (a ſketch of which is drawn at the bottom of theſe preſents,) in the following manner; that is to ſay,

ſay, A (Plate XII.) an iron cylinder; B a ſolid iron piſton, made to fit the cylinder; D a ſtrong frame, in which the cylinder is ſuſpended; E a ſtove to keep the bottom of the cylinder hot; F a counterſunk touch-hole, and near the bottom of the cylinder. As ſoon as the bottom is heated ſufficiently, pour a ſmall quantity of ſpirits of tar, or turpentine, into the funnel H, which falls on the hot part of the cylinder, and inſtantly the liquid is converted into an inflammable vapour; at the ſame moment raiſe the piſton, by means of the lever G, which ſucks in the external condenſed air, and alſo raiſes a light to the touch-hole; the confined vapour takes fire ſimilar to gunpowder, and, by the combined power of the inflammable and rarefied air, thus incorporated together, forces the piſton B up the frame, and alſo raiſes with it the long ſhaft K, which deſcends with the piſton to the bottom, and works the pump or other machinery at the oppoſite end at L. The two ſides of the frame 1 and 2 are made hollow like a groove, to guide the piſton in its return into the cylinder; the ſame operation continued, a conſtant motion is communicated.

Pl. XII. p. 155.



N. B. The quantity of ſpirits of tar, or turpentine, to be made uſe of, is always proportioned to the confined ſpace, in general, about ten drops to a cubic foot; this proceſs will produce an inflammable vapour force. In witneſs whereof, &c.

XXVII. Specification of the Patent granted to Mr. HECTOR CAMPBELL, of the Pariſh of St. Mary Magdalen, Bermondſey, in the County of Surrey, Chemiſt; for his Method of deſtroying the colouring Elements and Particles in coloured Rags, and other Materials uſed in making Paper.

Dated Nov. 28, 1792.

TO all to whom theſe preſents ſhall come, &c. Now KNOW YE that, in compliance with the ſaid proviſo, I the ſaid Hector Campbell do hereby declare, that my ſaid invention of an improved

proved method of deſtroying and taking away all the carbonic, oleaginous, and colouring, elements and particles in linen, cotton, hemp, and in all coloured rags and other materials uſed in making paper, in a manner hitherto unattempted in this kingdom, and at a much leſs expence than any method now in uſe, is deſcribed in manner following. I the ſaid Hector Campbell having practiſed, and ſtill practiſing, under circumſtances, the method invented by the French, (which I believe I firſt adopted for abſolute buſineſs in England,) of ſaturating a tub of water, or any other fit receiver, with oxygenated muriatic acid, and applying this liquor to a variety of bleachable articles; in the year one thouſand ſeven hundred and ninety-one, I took it up as a manufactory, and applied it to whitening coloured brown Hambro', and other cheap rags, both whole and in a reduced ſtate, for the purpoſes of ſelling rags, pulp, and other materials for making paper. But notwithſtanding the previous uſe of an alkaline ley, and, when the liquor was put to the article, the revolution of the veſſels, and the variety of plans to excite internal motion, ſuch as ſticks to catch and divide, internal revolving

and

and up-and-down powers, and levers to agitate and divide, all of which I practised, I still found the operation in preparing the said materials for making paper, in point of time, labour, inequality of beauty, and bleaching only to a certain degree, extremely imperfect. Therefore, from numerous considerations and experiments, and at a great expence of time, labour, and money, I discovered the following improved method: take of rag, coloured or not, or pulp, or any cotton, flaxen, hempen, or other, material fit to make paper, and let the first consideration be for what you want it, that is, how valuable you intend to make the article: wash the said material for making paper. When the material for making paper is wanted for making an inferior sort of paper, it does not require to be passed through an alkaline ley previous to bleaching, but may be bleached in the manner herein-after described: should the material be wanted for making better paper, it may be passed through an alkaline ley, cleansed from it, and then bleached in manner herein-after described; but this process of previously passing the material for making paper through an alkaline

line ley will not bleach, in one bleaching, beyond a certain degree, extremely inadequate to conſtitute ſuperior excellence. Therefore, to bleach the material in the beſt manner, take of either of the ſaid materials for making paper, and either paſs it through an alkaline ley previouſly or not; then bleach it in the manner herein-after deſcribed; then boil it in an alkaline ley; (a ſolution of cauſtic potaſh will anſwer the purpoſe;) the time of boiling, and the ſtrength of the ley, muſt be adjuſted by the nature and quality of the material, and the purpoſe it is wanted for; then waſh the alkali from the material, and preſent it again to be bleached. This proceſs will be found ſufficient, but, to bring the material to a great perfection, it may be repeated alternately; but, after the material has been alkalized, paſſing it through, or having any thing to do with what are termed the ſours, or vitriolic acid and water, or any other acid and water, is unneceſſary. Fine materials are conſiderably improved by bleaching, and then boiling in alkali, and then bleaching again; but more eſpecially coarſe, white, or brown, materials, ſuch as have never been coloured, will never ſo well

well have their carbonic, oleaginous, and ligneous, elements and particles (with which they abound) done away, or be brought to any ſtate of perfection, without the above proceſs of bleaching and boiling. The veſſel or receiver for bleaching the material in may be of any ſhape or dimenſion, and made of any ſubſtance capable of compreſſion and condenſation. I do it in receivers made of wood, in glazed earthen veſſels, and other veſſels, of any ſhape or dimenſion; and indeed it may well be done in any receiver, the ſubſtance of which is devoid of oil and metal, and not ſubject to be materially affected by the oxygen or acid. The quantity of the materials to be bleached ſhould contain about its own weight of water, the ſuperabundant quantity of water being preſſed out. The material muſt then be opened by a machine, called by the cotton manufacturers a devil, or ſome machine of that nature. Then diſtribute the material in the receiver thinly, or one or more frames or layers, placing them ſo as not to come in contact with each other; or the material may be placed in the body of the receiver, and turned round in it, ſo as that the bleaching power may have a free commu-

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nication with all parts of the material. Then cloſe the receiver; make one or more holes or apertures, in the ſide, or other part of the receiver, of a ſufficient ſize to admit the end or mouth of a retort; then get one or more retorts, or other proper veſſel; put therein a ſubſtance containing oxygen or vital air, which may be found in many ſubſtances beſides manganeſe; but as manganeſe particularly abounds with oxygen, and therefore a quantity of it is ready made by nature, take of manganeſe (ſuch as contains the moſt oxygen) a third part of any given quantity, and mix it with a proportion of two third parts of marine, or ſea ſalt, but this proportion muſt be governed by the aërated ſtate of the manganeſe; mix them well together previous to their being put into the retort, and, with the manganeſe and ſea ſalt ſo mixed, put in ſulphuric or vitriolic acid, of a quantity equal to, or rather more than the ſea ſalt. Then join the neck or mouth of the retort with the receiver, and lute it; or, if the retort is tubulated, you may join it to the receiver and lute it, before it is charged as aforeſaid. The number of retorts to be applied cannot be aſcertained, as they will

depend on the ſize of the receiver, and the quantity of material put in to be bleached. The retorts ſhould reſt on ſand kept continually heated for working, or heat otherwiſe ſufficiently communicated would do. The bleaching will now commence, which ſhould be continued until the material is ſufficiently whitened for the purpoſe wanted, which may be known by looking at it. Then take it out, and add more material to be bleached in the ſame manner, and ſo on, again charging the retort, in manner aforeſaid, ſtrong enough to proceed; taking care that the material to be bleached ſhould never wait for the bleaching power, or the bleaching power be played upon a material which is no longer bleachable. And the material thus bleached being immerged and waſhed in water, to take away the acid contained in it, becomes fit to be applied for the purpoſe of making paper, and may be proceeded on accordingly. In witneſs whereof, &c.

XXVIII.

XXVIII. An Idea of a ſimple Inſtrument for meaſuring Diſtances, from one Station only; invented by JAMES PEACOCK, Eſq. of Finſbury-ſquare, Architect.

WITH A PLATE.

THE purpoſes which this inſtrument is to ſerve are as follow: viz. Firſt, to meaſure any diſtance, *within one firſt aſſumed*, with great accuracy and expedition, from one ſtation only; *i. e.* ſuppoſe the aſſumed diſtance be five miles, then the inſtrument being fitted to meaſure that extent, but no greater, will meaſure any leſs diſtance, with a degree of accuracy which, it is apprehended, cannot be obtained by the uſual modes of actual meaſurement; provided the obſervations are carefully made.

Secondly, the apparatus, with a ſimple increaſe of parts, may be fitted to meaſure diſtances be-

tween remote objects, (within certain limits,) from one station.

And, Thirdly, it will measure the slant or perpendicular altitudes of remote objects, also from one station.

These purposes to be effected without calculation, instantaneously, and by inspection only.

The instrument is proposed to be here described in its simplest form, and as applicable to measuring distances from any station to remote objects only; because, if it succeeds in this respect, its application to distances between remote objects, and to remote altitudes, perpendicular, inclined, or reclined, will succeed also; and to the same degree of truth, provided the observations are accurately made.

The principles upon which the instrument should be constructed are as follow, viz.

The

The late general Roy having, with great labour and exactneſs, meaſured ſeveral baſe lines in this kingdom, for aſtronomical purpoſes, it is propoſed to uſe ſuch baſe lines to fix the ultimate power of the inſtrument. Thus,

Having dug for, and found, both the limits of one of ſuch baſe lines, it is propoſed to erect a ſmall ſhed or hovel over each, in one of which the inſtrument is to be placed for adjuſtment, and in the other a very vivid, ſlender, and ſteady light; both of theſe to be fixed over the preciſe limits of the baſe.

A dark clear night muſt be choſen for giving the inſtrument its faculty, the mode of doing which will be hinted preſently.

In the mean time the parts and form of the inſtrument muſt be ſomewhat like the annexed ſketch, in which A B (Plate XIII.) is a ſtrait braſs rod, or plate of ſome preciſe meaſure, as a foot, yard, or fathom, &c.

We

We will ſuppoſe it to be a fathom, and that the utmoſt power of the inſtrument be limited to five miles; this rod or plate we will ſuppoſe divided into 4400 parts, being the number of fathoms in five miles, or rather that the ſaid rod or plate be divided into 440 parts, and a kind of nonius, into 10 parts, be properly applied thereto.

Near the end of the rod, or plate, at A, muſt be fixed a teleſcope H, whoſe line of collimation ſhall be coincident with the limit of the rod, and at a right angle with the graduated edge thereof.

Upon the ſame end of the rod muſt be fixed, in a vertical poſition, a ſpeculum or mirror DE, with its face towards the teleſcope, whoſe angles BAE, and HAD, ſhall be each exactly forty-five degrees.

At the other end of the rod muſt be placed a ſimilar mirror FG, with its face towards the other end of the baſe C, the inſtrument will then be prepared for adjuſtment. Let it then be placed in the hovel, ſo that the end A of the rod ſhall be

be exactly upon one limit of the baſe, at the ſame time that the object C, or the bright light upon the other limit of the baſe, ſhall be ſeen by, and be coincident with, the axis of the teleſcope; there the inſtrument muſt be firmly fixed.

An aſſiſtant is then to move the mirror FG, at the other end of the rod, upon a pivot which is to coincide with its centre, until the image of the light at C ſhall be brought to appear, by reflection, in the center of the mirror DE, and be exactly coincident with the real object, ſeen directly through the teleſcope. The proper inclination of the plane of the mirror, to the edge of the rod, will be then obtained, which is to be firmly fixed for uſe.

The angles CBG and ABF will then be equal to an extreme exactneſs. This mirror is to be movable in the direction BA, by means of an indented rod, to ſlide in a groove in the graduated rod, to be managed by a ſcrew within reach of the hand, at the ſame time that the eye is obſerving the object in the direction HC.

It

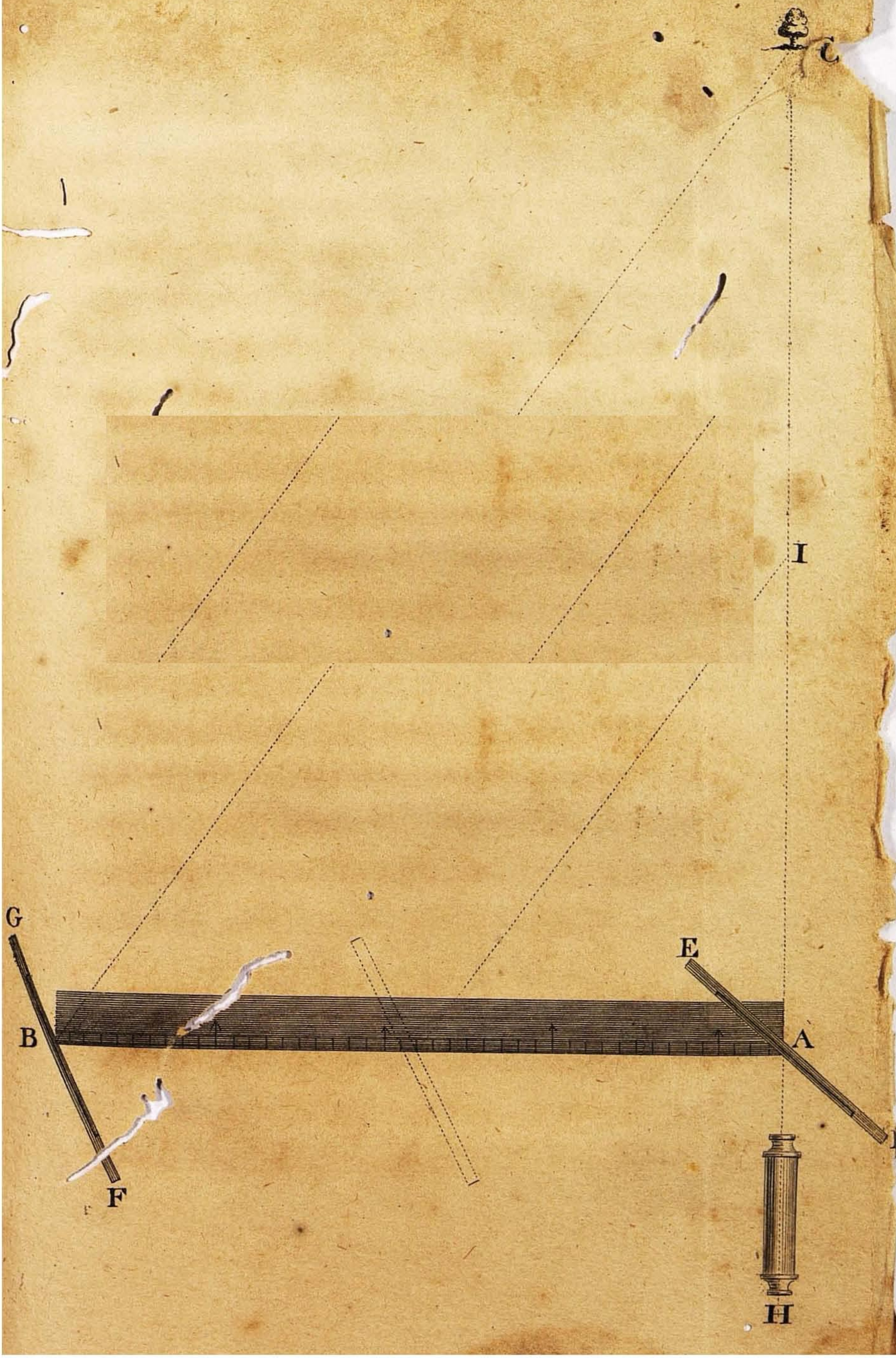
It is ſuppoſed the following example will make the whole plain.

Required the diſtance A I in fathoms. Place the teleſcope end at A, and move the inſtrument, until ſome certain point or angle, in the object I, cuts the interſection of the croſs hairs in the teleſcope, and there fix the inſtrument; keep the object in view, while moving the mirror FG, by turning the ſcrew connected therewith backwards or forwards, until the reflected image of the ſame point or angle, in the object I, ſhall appear in an exact vertical coincidence with that of the real object.

The diſtance required will then be ſhewn by inſpection, and may be had to any degree of exactneſs, by the aid of a micrometer properly adapted to the purpoſe.

Thus much ſeems ſufficient to furniſh a competent idea of the invention in a general way; the application of a reduced magnifying tube to the mirror FG, of the ſame power as the teleſcope; of

Pl. XIII. p.



of a thermometer and table, to correct the expansion and contraction of the rod in different temperatures of the atmosphere; the matter of which the mirrors should be made, to avoid errors which would arise from refraction; and various other minutiæ, are purposely omitted for the sake of brevity, and because the artists who construct mathematical instruments can readily furnish these parts in a much better manner than the writer of this can direct.

The important services to maritime, military, and civil, surveying, which may be derived from an instrument of this kind, if accurately constructed, and used with care, are too numerous to be insisted upon here.

XXIX. On a Method of aſcertaining an univerſal and invariable Standard of Meaſure; by Mr. Robert Leslie, Watch-maker, of London.

THROWING together the inequalities of ſolar days, a mean interval, or day, has been found, and divided, by very general conſent, into eighty-ſix thouſand four hundred equal parts.

A pendulum, vibrating in ſmall and equal arcs, may be ſo adjuſted in its length, as, by its vibrations, to make this diviſion of the earth's motion into eighty-ſix thouſand four hundred equal parts, called ſeconds of mean time.

Such a pendulum then becomes itſelf a meaſure of determinate length, to which all others may be referred, as to a ſtandard.

But

But even the pendulum is not without its uncertainties.

Firſt, The difficulty of aſcertaining in practice its centre of oſcillation, as depending on the form of the bob, and its diſtance from the point of ſuſpenſion; and the effect of the weight of the ſuſpending wire, towards diſplacing the centre of oſcillation, (that centre being ſeated within the body of the bob, and therefore inacceſſible to meaſurement,) are ſources of conſiderable uncertainty.

Secondly, Both theory and experience prove that, to preſerve its iſochroniſm, it muſt be ſhorter towards the equator, and longer towards the poles.

Thirdly, To continue ſmall and equal vibrations, through a ſufficient length of time, and to count theſe vibrations, machinery and a power are neceſſary, which may exert a ſmall but conſtant effort to renew the waſte of motion; and the difficulty is, ſo to apply theſe as that they ſhall neither retard nor accelerate the vibrations.

In order to avoid the uncertainties which respect the centre of oscillation, I have substituted an uniform cylindrical rod, without a bob, for the pendulum.

Could the diameter of such a rod be infinitely small, the centre of oscillation would be exactly as two-thirds of the whole length, measured from the point of suspension. Giving it a diameter which shall render it sufficiently inflexible, the centre will be displaced indeed, but, in a second rod, not the (1) 600,000th part of its length, and not the hundredth part so much as in a second pendulum with a bob. This displacement is so infinitely minute then, that we may consider the centre of oscillation, for all practical purposes, as residing at two-thirds of the length from the point of suspension. The distance between these two centres might be easily and accurately ascertained in practice.

But the whole rod is better for a standard than any portion of it, because sensibly defined at both its extremities.

The

The uncertainty arifing from the difference of length requifite for the fecond pendulum or rod, in different latitudes, may be avoided by fixing on fome one latitude, to which our ftandard fhall refer.

To give an uniform impulfe to the rod, to renew the wafte of motion occafioned by the friction and refiftance of the air, I have made an improvement on the fcapement of the common clock, which effectually prevents any irregularity, that might otherwife be occafioned by the unequal action of the wheels.

To make the experiment, nothing more is neceffary than fuch a clock, and a piece of ftraight iron wire, of about the diameter of a common goofe-quill; and the length that will be found to vibrate feconds will be about fifty-eight Englifh inches, from the point of fufpenfion to the end of the rod. The moft certain way of proceeding in the experiment is, to have the rod at firft too long, and to continue cutting fmall portions off the lower end, till the clock is brought to time.

The

The advantages that the above has over all other pendulums, for aſcertaining a univerſal ſtandard of meaſure, are,

Firſt, That it can be regulated with more certainty.

Secondly, That it is one-third longer, and therefore can be divided with more certainty.

And, Thirdly, Its ſimplicity, which puts it in the power of any perſon to make the experiment with the greateſt accuracy, even without the uſe of figures; the whole (after the clock is regulated) being aſcertained by one ſingle menſuration of a ſtraight line.

XXX. Account of the Method of making Stilton Cheeſe.

From the general View of the Agriculture of the County of Leiceſter; drawn up, for the Conſideration of the Board of Agriculture, by Mr. JOHN MONK, of Bears-combe, Devon.

STILTON cheeſe is made in moſt of the villages round Melton Mowbray, but I found it impoſſible to get at the ſecret of making it from the dairy-people; and, from the converſation I had with one of the firſt managers, I ſhould ſuppoſe two cheeſes were never made alike, as it depends upon ſoil, herbage, ſeaſons, heat, cold, wet, dry, &c. &c. There is no doubt but thoſe cheeſes require a great deal of care and attention, owing, I ſhould ſuppoſe, to their richneſs and thickneſs. They run from eight to ſixteen or eighteen pounds, very ſeldom larger, and are ſold at one ſhilling *per* pound. Moſt of the inns in the county retail them, the price thirteen and fourteen pence

per

per pound. I was informed by the maker, that they were never better for the table than at a year old, but I believe they are ſeldom cut ſo ſoon. The *beſt* of the other ſort of cheeſe made in the county is, in my opinion, better than the generality of the Stilton, as it is but ſeldom you meet with a real good one.

In reſpect to the grand ſecret of making Stilton cheeſe, I ſhould have left the county without acquiring the proceſs, if it had not been for the politeneſs and attention of Major Cheſelden, of Somerby, who, upon my acquainting him with my diſappointment, kindly undertook to procure it for me from one of his tenants, who was among the firſt for making it. The following is the receipt.

Take the night's cream, and put it to the morning's new milk, with the rennet; when the curd is come, it is not to be broken, as is done with other cheeſes, but take it out with a ſoil-diſh altogether, and place it in a ſieve to drain gradually, and, as it drains, keep gradually preſſing it till it becomes

firm

firm and dry; then place it in a wooden hoop; afterwards to be kept dry on boards, turned frequently, with cloth binders round it, which are to be tightened as occaſion requires.

N. B. The dairy-maid muſt not be diſheartened, if ſhe does not ſucceed perfectly in her firſt attempt.

In the dairies which I viſited, the cheeſes, after being taken out of the wooden hoop, were bound tight round with a cloth, which cloth was changed every day, until the cheeſe became firm enough to ſupport itſelf; after the cloth was taken off, they were rubbed every day all over, for two or three months, with a bruſh; and if the weather was damp or moiſt, twice a day; and, even before the cloth was taken off, the top and bottom were well rubbed every day.

XXXI. On the Preservation of Sea-Water from Putrefaction, by Means of Quick-lime; by Mr. THOMAS HENRY, of Manchester, F. R. S.

From the MEMOIRS of the LITERARY and PHILOSOPHICAL SOCIETY of MANCHESTER.

IT has been frequently remarked by chemical and philosophical writers, that a new experiment is seldom made in vain; though the operator may even fail of attaining the immediate object of his pursuit, he may yet, fortuitously, acquire the knowledge of some new fact, which may be productive of improvement and advantage to science.

About the time I published my method of preserving water, at sea, from putrefaction, &c*. a gen-

* An account of a method of preserving water, at sea, from putrefaction, and of restoring to the water its original purity and pleasantness, by a cheap and easy process, &c. London, 1781.

a gentleman who had obtained a quantity of ſea-water, for the purpoſe of bathing a child, complained to me that it ſoon became putrid, and requeſted that I would think of ſome expedient to preſerve it.

The principal ſalts contained in ſea-water are, firſt, common marine or culinary ſalt, compounded of foſſil alkali and marine acid; ſecondly, a ſalt formed by the union of the ſame acid with magneſian earth; and, laſtly, a ſmall quantity of ſelenite. The quantity of ſaline matter contained in a pint of ſea-water, in the Britiſh ſeas, is, according to Newmann, about an ounce in each pint*. When this water is ſlowly evaporated, the common ſalt

* In Sir Torbern Bergman's analyſis of ſea-water taken up, in the beginning of June 1776, about the latitude of the Canaries, from the depth of ſixty fathoms, the ſolid contents of a pint of the water were,

Common ſalt	$253\frac{6}{11}$ grains.
Salited magneſia	$69\frac{1}{11}$
Gypſum .	$8\frac{2}{11}$
Total	$330\frac{9}{11}$, or 5 drachms, 1 ſcruple, $10\frac{9}{11}$ grains.

 firſt

firſt cryſtallizes, and the marine magneſian ſalt is left in what is called the bittern, from which, by a ſubſequent proceſs, the purging bitter ſalt, commonly named Epſom ſalt, is obtained. By this ſeparation the ſea or bay ſalt is rendered much better adapted for the preſervation of animal ſubſtances than the ſalt of the rocks and ſprings in Cheſhire and Worceſterſhire, where, from what I apprehend to be a miſtaken notion, that this bittern does not exiſt in the brine, the liquor is ſo haſtily evaporated, that the cryſtals of common ſalt retain much of the magneſian ſalt among them. For the magneſian ſalt is highly ſeptic, and greatly impairs the properties of the others *.

The two methods which occurred to me, as likely to anſwer the wiſhes of my friend, were, firſt, the addition of quick-lime; and, ſecondly, that of common ſalt. To the trial of the former I was induced by its known antiſeptic effects on

* At ſome of the works at Northwich, the evaporation is carried on in ſo gentle a manner, that large cubical cryſtals are formed; and the ſalt thus prepared is ſaid to be equal in ſtrength to bay ſalt.

common

common water, and it is aſcertained, that a ſmall portion of common ſalt promotes, whereas a larger retards, putrefaction.

Experiment I. To one quart of ſea-water were added two ſcruples of freſh quick-lime; to another, half an ounce of common culinary ſalt; and a third was kept as a ſtandard, without any addition. The mouths of the bottles being looſely covered with paper, they were expoſed to the action of the ſun, in ſome of the hotteſt weather of the laſt ſummer.

In about a week the ſtandard became very offenſive; and the water with the additional quantity of ſalt did not continue ſweet many hours longer; whereas, that with lime continued many months, without ever exhibiting the leaſt marks of putridity.

It ſeemed probable, that all, or ſome of three changes had been effected by this proceſs. It was ſuſpected that quick-lime might decompoſe the marine ſalt with an alkaline baſis, a power which it has

has lately been ſuppoſed to poſſeſs, under certain circumſtances; or that its antiſeptic powers might depend on the formation of a lime-water; by either of which, a material, and perhaps unfavourable, alteration might be produced: or, laſtly, that the precipitation of the earthy baſis of the magneſian ſalt, by the quick-lime, might contribute to the preſervation of the ſea-water.

Experiments II. and III. On ſubmitting the water to which the lime had been added to the common trials for detecting a diſengaged alkali, no ſigns of ſuch a ſalt were diſcovered. And, upon blowing into it a long continued ſtream of air from the lungs, no precipitation or cloudineſs enſued, as in the caſe of lime-water.

It remained to ſee whether the precipitation of the magneſian earth, from its acid, had been effected. Under ſome circumſtances it has been proved, by the very ingenious Dr. Black, that magneſia will precipitate calcareous earth from acids. As, for inſtance, if mild magneſia be thrown into a ſolution of calcareous earth in marine

rine or nitrous acid, the calcareous earth will be precipitated; the ſum of the attractions between this earth and fixed air, and between the magneſia and the acid, being greater than thoſe which ſubſiſted between the magneſia and the air, and between the calcareous earth and the acid. But, if cauſtic calcareous earth be added to a ſolution of magneſia in thoſe acids, its affinity to the acid is, in this ſtate, increaſed, no fixed air attracts it, and it precipitates the magneſia.

Experiment IV. To ſome of the ſea-water which had been kept as a ſtandard, ſome lime-water was added, and a turbidneſs immediately took place, ſucceeded by a copious precipitation. This, at firſt, convinced an ingenious member of this ſociety, Dr. Eaſon, who happened to be preſent, and myſelf, that we had diſcovered the manner in which the lime acted, and the reaſon why no lime-water was produced. But, on adding lime-water alſo to ſome of the ſea-water which had been preſerved by the lime, a cloudineſs and precipitation, reſembling the former, took place, and ſtaggered us in our theory; for we imagined, that the

the portion of quick-lime had been ſufficient to have precipitated the whole of the magneſia which the water might have contained; and we now ſuſpected, that the ſolution of the lime was therefore probably prevented by the ſea-ſalt.

Other avocations prevented my purſuing the enquiry at that time, but I have ſince reſumed it, and have been able to elucidate the whole matter.

Experiment V. Into a ſtrong ſolution of the common Cheſhire ſalt, ſome lime-water was poured. The mixture became turbid, and a white earth was ſeparated, which did not ſink to the bottom of the glaſs, but was ſuſpended, partly on the ſurface, and partly in the midſt of the liquor.

But whence did this precipitate proceed? Was it the lime thrown down by the ſalt; or did the lime ſeparate ſomething from the common ſalt?

Experiment VI. To a portion of the ſame ſolution, inſtead of lime-water, ſome drops of a ſolution

lution of foſſil alkali were added, and the ſame ap-pearances occurred.

Experiment VII. Each of theſe precipitates were rapidly and wholly diſſolved, (the greateſt part of the water being firſt poured off,) on the addition of a few drops of dilute vitriolic acid; a proof that the precipitated earth was magneſia.

Experiment VIII. To determine whether the addition of a portion of bitter purging ſalt, to a ſolution of common ſalt, would prevent the forming of lime-water, with an equal quantity of lime to that which had preſerved the ſea-water, I mixed twenty grains of quick-lime, ſeven drachms of common ſalt, and one drachm of bitter purging ſalt, with a pint of rain-water; but no lime-water was produced. Whereas, a lime-water was formed by an equal quantity of lime with a pint of rain-water and alſo with a ſolution of common ſalt, from which the earthy matter it contained had been previouſly precipated by foſſil alkali, and the alkali neutralized by marine-acid.

 The

The next queſtion that preſented itſelf to my inveſtigation was, whether the common Cheſhire ſalt was ſo impregnated with magneſian ſalt as to prevent the forming lime-water, with a like quantity of lime, when uſed in the proportion of an ounce of ſalt to a pint of water.

Experiment IX. Theſe proportions of Cheſhire ſalt, quick-lime, and rain-water, being mixed, and ſuffered to ſtand a ſufficient time, the filtered liquor exhibited no ſigns of being impregnated with unneutralized lime; but, on adding a few drops of *lixivium tartari*, it inſtantly became very turbid, and depoſited a ſediment, which, inſtead of diſappearing on the addition of vitriolic acid, formed a ſelenite with it, and again ſettled at the bottom of the glaſs.

Experiment X. Five grains of quick-lime being added to the mixture of the ninth experiment, the liquor, after due time, being filtered and ſubjected to the uſual teſt, exhibited evident marks of having become a lime-water.

I now

I now began to ſuſpect, that the portion of quick-lime added to the ſea-water, in the firſt experiment, had not been ſufficient to precipitate the whole of the magneſia from its acid, and, having ſome of the mixture of that experiment ſtill by me, I again turned my attention to it.

Experiment XI. The remaining part of the ſea-water, to which the quick-lime had been added, was about a pint and a half. Lime-water being added to a ſmall part of it, the ſame turbid appearance took place as formerly.

Experiment XII. On the addition of another drachm of lime, the water, when filtered, no longer became turbid on the mixture of lime-water with it; but it did not yet exhibit any ſigns of being itſelf a lime-water.

Experiment XIII. But, when I added another drachm of lime, a lime-water was formed. For the water now became very turbid on blowing air into it from the lungs.

 Theſe

These experiments, therefore, not only prove that ſea-water may be preſerved for the purpoſes of bathing, by means of quick-lime, without forming a lime-water, but they point out the *rationale* of this phænomenon; and alſo inſtruct us what portion of lime may be uſed, without a lime-water being produced.

It appears that quick-lime, diſſolved in water, precipitates the magneſian earth from the marine acid, with which it is united in the ſea-water, and, uniting with that acid, is retained in the water, under the form of a marine ſelenite. What the water loſes, therefore, of one ſalt, it gains of another. At the ſame time the magneſia, being precipitated by a cauſtic calcareous earth, falls in a ſtate ſimilar to that to which it is reduced by calcination, viz. void of fixed air. In this ſtate I have formerly proved, by a train of experiments, that it is ſtrongly antiſeptic *. Being inſoluble, the

* From theſe experiments it appeared, that *magneſia alba*, while poſſeſſed of its fixed air, is highly ſeptic to animal fleſh, but antiſeptic to bile; whereas, when calcined, and deprived

the water is preferved without forming any com-bination with it; and the only alteration that is made in the component parts of the fea-water is, that the earthy marine falt changes its bafis of magnefia for one that is calcareous.

We alfo fee that there are limits to the addition of quick-lime, beyond which we cannot proceed without forming lime-water. The quantity of two fcruples to a quart of fea-water, though not fufficient to decompofe the whole of the magne-fian falt, was yet adequate to the prefervation of the water. One drachm more of quick-lime fepa-rated the whole of the magnefia, and, when a far-ther addition was made, a lime-water was imme-diately formed *.

The properties of common falt, as an antifep-tic, are greatly weakened by the portion of ma-

prived of its fixed air, it is ftrongly antifeptic both to flefh and bile.

See Henry's Experiments and Obfervations, p. 58, et feq.

* Thefe proportions may vary, according to the ftrength of the quick-lime employed.

rine

rine magnefian falt mixed with it. It is probable that the marine felenite may be lefs feptic, and lefs foluble in water, fo as to feparate during the evaporation of the brine; if fo, the addition of quick-lime may be ufeful previous to that procefs at the falt-works. But we are fo little acquainted with the properties of calcareous falts, that, at prefent, we cannot determine what might be the effects of fuch a practice. I propofe, however, at fome future opportunity, to try whether the calcareous marine falt will thus feparate; and whether it be, in itfelf, feptic or antifeptic.

XXXII. Continuation of Mr. BERTHOLLET'S Method of bleaching Cloths and Thread.

(FROM p. 130.)

M. CAILLAU made a great number of experiments at Paris, refpecting the new method of bleaching; but the greateft part of thefe experiments were made upon cotton, which is more eafy to bleach, and does not require leys fo often or fo ftrong as flax or hemp. He alfo went to St. Quentin,

Quentin, to perform the operation upon the cloth of that country; but he found that all the cloths, which he had bleached to the ſatisfaction of the manufacturers, became again of a reddiſh colour when they were expoſed to a common ley, or even when they were left for ſome time in a warehouſe.

M. Décroiſille experienced at Rouen the ſame accident to the cloths which he had bleached; and indeed I obſerved the ſame defect in the ſmall pieces which I had bleached in my elaboratory. Neverthleſs M. Bonjour at Valenciennes, and M. Welter at Liſle, maintain that the cloths and thread which they had bleached preſerved their white colour perfectly, in all the trials to which they were ſubmitted. I ſoon convinced myſelf that the imperfection of my bleaching was owing to the manner in which I had made uſe of the leys. I had contented myſelf, in thoſe trials on ſmall pieces which I made in my elaboratory, to pour the hot alkaline ſolution into a veſſel where I placed the pieces; it there became cool very rapidly, and therefore did not act with ſufficient power; but when I let theſe pieces remain in the liquor,

liquor, which I kept nearly in a boiling heat during the ſpace of two or three hours, they were then no longer ſubject to the abovementioned defects; it was therefore merely the weakneſs of the leys which had occaſioned the accidents which were experienced by Meſſrs. Caillau, Décroiſille, and myſelf. It is neceſſary that the colour of the cloth ſhould not be changed by the laſt ley, and this is the ſureſt mark that the bleaching is finiſhed; nevertheleſs, after this laſt action of the ley, it is proper to put the cloth, for a few moments, in the bleaching liquor.

After this laſt immerſion, it is neceſſary to plunge the cloths in ſour milk, or in water acidulated with vitriolic acid. I do not know the moſt convenient proportion of vitriolic acid, but it appeared to me that we might ſucceſsfully, and without danger, make uſe of one part, in weight, of this acid to fifty of water. We muſt keep the cloths during about half an hour in this liquor warmed; after which it is proper to ſqueeze them well, and plunge them directly into common water; for, if an evaporation ſhould take place, the

vitriolic

vitriolic acid, becoming thereby concentrated, would corrode them. The cloths being then well washed, require only to be dried and dressed in the ordinary manner, according to their different sorts*.

It is of the utmost importance to take care that the water is not too strongly impregnated with vitriolic acid; it is to an inattention of this sort that I attribute an accident that happened to M. Bonjour. Some cloths were sent to him, to try the merit of this method of bleaching; he made use of two operations, one of which was intended for the finer cloths, such as gauzes and cambrics, the other for the coarser cloths. The bleaching of the first succeeded perfectly well, but the person who had been trusted to acidulate the water, having put, for a small quantity of cloth, the same portion of acid he had been used to employ for a greater quantity, the cloths were much weakened; an accident which had never occurred to him in former operations, though he had conducted them for more than a year.

* I have found that one of the uses of the vitriolic acid, employed after the bleaching of the cloths, is to take away a portion of iron which they contain.

The bleaching of cotton cloth is much eaſier and ſhorter; two leys, or at moſt three, and as many immerſions in the bleaching liquor, are ſufficient for them; as they are bleached ſo eaſily, it is advantageous, when there are flaxen, hempen, and cotton, cloths to be bleached, to reſerve for the cotton the liquors which have been previouſly weakened by the cloths of flax or hemp; for, it is œconomical to exhauſt the liquors as much as poſſible, and thoſe which are conſiderably weakened ſtill ſuffice for the cotton, although they have ſcarcely any action upon hemp or flax.

Thread, in the common way of bleaching, is attended with a far greater number of difficulties than cloth, becauſe of the immenſe number of ſurfaces which it is neceſſary to preſent ſucceſſively to the action of the atmoſphere; ſome part of theſe difficulties occur in bleaching with the oxygenated muriatic acid, nevertheleſs, in the end, it is more advantageous with reſpect to thread than with reſpect to cloth. Mr. Welter has formed at Liſle, with two partners, an eſtabliſhment for bleaching thread, with great ſucceſs, and he has already

already begun some others. He has found that ten or twelve leys, and as many immerſions, are required for ſome ſorts of thread; and that the thread may be ſurrounded with the liquor, it is neceſſary to place it, quite looſely, in a baſket, which permits the liquor to penetrate to all its ſurfaces; when the liquor is much weakened, it is ſtill fit to be uſed for the bleaching of cotton.

I had, in the beginning of my experiments, tried whether the vapour would not be preferable to the oxygenated muriatic acid in a liquid ſtate, and I obſerved that it bleached with greater quickneſs; but, whatever precautions I employed, it appeared to me that a conſiderable loſs of it took place; that thoſe parts of the cloths which were the moſt expoſed to it were ſubject to be weakened; and that it was more difficult to obtain an equal whiteneſs throughout.

To prevent all the accidents which may reſult from the liquor acting with too great power, it is important to have a means of meaſuring its force. M. Decroiſille thought of uſing, for that purpoſe,

a solution of indigo in vitriolic acid. He takes one part of indigo, reduced into fine powder, and eight parts of concentrated vitriolic acid; this mixture is put into a matrafs, which is kept, during fome hours, in a water-bath; when the folution is finifhed, it is diluted with a thoufand parts of water. To try the power of the oxygenated muriatic acid, one meafure of this folution is put into a graduated glafs tube, and fome of the liquor is gradually added to it, until the colour of the indigo is deftroyed. We muft firft determine how many meafures of a liquor, the goodnefs of which has been afcertained by experiments made upon cloth, are neceffary to deftroy the colour of one meafure of the folution of indigo, and this number will ferve to eftimate the refpective ftrength of all the liquors which it may be neceffary to compare with it. M. Watt employs, in the fame manner, a folution of cochineal.

In the beginning of my experiments I was defired to go to Javelle, to fhew the manner of preparing the oxygenated muriatic acid, and of ufing it for bleaching. I made no objections to fhew the

and, in the veſſel where the gas is to be concentrated, one pound of water, and five ounces of potaſh, which ſhould be diſſolved in the water. The Javelle liquor has a ſomewhat reddiſh appearance, occaſioned by a ſmall quantity of manganeſe, which either paſſes in the diſtillation becauſe an intermediate veſſel is not uſed, or exiſts in the potaſh; moſt kinds of which contain it, as I have well convinced myſelf.

This liquor may be diluted with from ten to twelve parts of water, and, after this, it bleaches more ſpeedily than the liquor itſelf; but, without ſpeaking of the imperfections of the method which is deſcribed in the publications from Javelle, and which can only ſuffice for cotton, we are not able to bleach near the ſame quantity of cloth with the oxygenated muriatic acid combined in this manner with an alkali, as might be bleached with the ſame quantity of that acid mixed with water alone; becauſe there is formed a portion of that neutral ſalt which is known at preſent by the name of oxygenated muriate of potaſh, and in which the oxygene becomes concentrated.

trated. Now all the oxygene which enters into the compofition of this salt is rendered ufelefs for bleaching; becaufe the oxygenated muriate of potafh does not deftroy colours, as I have obferved in my memoir upon certain combinations of the oxygenated muriatic acid, in which I have given in detail the phenomena which potafh prefents with the oxygenated muriatic acid. (*Mémoires de l'Académie de Turin.*) To thefe confiderations muft be added an increafe of the price, occafioned by the quantity of potafh in which the gas is received; and yet one of the old manufacturers at Javelle demanded an exclufive patent in England for this *new procefs of his invention.*

I hope that the account which I have juft given will be fufficient to guide thofe who may be willing to undertake the new method of bleaching. Obfervation, without doubt, will give us the means of perfecting it, and I fhall inform the public of whatever fhall come to my knowledge on that head. There is, however, an important part upon which I am not as yet able to fay any thing with precifion; namely, the manner of extracting the mineral alkali from the refidue of the diftil-

the procefs, as I wifhed to fee it more extended. I therefore went twice to Javelle, and performed the diftillation of the oxygenated muriatic acid with veffels which I had carried thither; I alfo bleached fome pieces of cloth, as fpecimens. At that time I ftill employed a concentrated liquor, and I mixed with it a fmall quantity of alkali. Some time after, the manufacturers at Javelle publifhed, in different journals, that they had difcovered a particular liquor which they called Javelle ley, *(Leffive de Javelle,)* and which had the property of bleaching cloth, by an immerfion of fome hours only. The change they had made in the procefs, which I had performed in their prefence, confifted of putting fome alkali into the water which receives the gas; this enables the liquor to become much more concentrated, fo that it may be diluted with feveral times its own quantity of water, before it is ufed.

Thefe are the proportions which yielded me a liquor fimilar to the pretended Javelle ley; two ounces and a half of common falt, two ounces of vitriolic acid, fix drachms of calx of manganefe,

and,

diſtillations, which, for that purpoſe, I directed to be collected in a veſſel. I tried, upon this reſidue, a proceſs which M. de Morveau communicated to me, and which therefore belongs to him; and I extracted the mineral alkali from it. M. de Morveau had the goodneſs, in compliance with my requeſt, to make ſome experiments upon this reſidue; and, from his firſt trials, he ſuppoſed that the benefit to be made from it would nearly defray all the expences of the oxygenated muriatic acid, ſo that the liquor would coſt little or nothing, and that there would remain only the charge of the leys. I am acquainted with ſeveral proceſſes proper for obtaining this object; but I am not at liberty to diſcloſe them, as they were communicated to me in confidence.

If the manufacture of the vitriolic acid were united with the bleaching eſtabliſhment, this acid, to which the greateſt part of the expence of the bleaching liquor is owing, might be obtained at a much leſs price than that at which it is now ſold, particularly as the charge of concentrating it might be avoided. There is a hope of ſeeing the manu-

manufacturing of this acid perfected by leaving off the use of nitre, and diminishing the loss of the vapours. (*Encyclopédie Méthodique, p.* 357.) By the union of the above circumstances, the price of the liquor would be reduced to nothing.

Besides, the art of using the leys may be perfected by the help of machines; and, when the power of the alkali is exhausted, by being saturated, either with extractive matter, or with colouring particles, it would be easy, at least in places where fuel is cheap, to evaporate the leys to dryness, and to restore the strength of the alkali, by calcining the substances with which it is saturated.

TO BE CONCLUDED IN OUR NEXT.

XXXIII. On the Manner of rendering Leather impermeable to Water, without diminiſhing its Strength, or its Suppleneſs, and without ſenſibly augmenting its Price: by the Chevalier de St. Real.

From the Memoirs of the Academy of Sciences of Turin.

THIS queſtion, propoſed by the Academy of Lyons, was notified to the public in the *Journal de Phyſique*, of the month of October, 1788; and the term fixed for the reception of anſwers was the firſt of April, 1789.

The *Journal de Phyſique* does not arrive in foreign countries until about a month after it has been publiſhed in Paris, ſo that I had no knowledge of the queſtion propoſed by the Academy of Lyons, till toward the end of November, 1788. If I had wiſhed to employ myſelf upon this ſubject,

ject, with a view to obtain the prize, I ſhould have been obliged to make, in the courſe of three months and a half, experiments and operations which every amateur of the arts well knows are not finiſhed, in the manufacturing way, in leſs than two or three years, this being really the time required for tanning, according to the ordinary method, the green hide of an ox or cow, which it is required to convert into ſtrong ſole-leather.

Nevertheleſs, it would have been deſirable to make experiments relating to tanning, as theſe experiments, while they led to the improvement of an uſeful art, might at the ſame time have prepared the way for thoſe which were to be tried, in order to fulfil the object of the propoſed queſtion; either by giving ſome light reſpecting the nature of leather, or by enabling us to chooſe, among the various methods of preparing it, thoſe which would leaſt injure its ſtrength and ſuppleneſs, and proportionally augment its compactneſs. But the impoſſibility of finiſhing theſe operations in ſo ſhort a time, my diſtance from any

any tannery, and the multiplicity of my engagements, obliged me to direct my views principally to the curriers art. I have not, however, neglected making ſome analytical experiments, which have enabled me to judge of the nature of leather, and of the various manners of preparing it. Theſe experiments are too incomplete to be of any great uſe; but they may ſerve as preliminaries, to thoſe who ſhall be willing to undertake a more regular work upon ſo important an art.

I could not, therefore, flatter myſelf that I ſhould obtain the prize, which the Academy of Lyons are to decree at the end of the enſuing Auguſt. It is reſerved, without doubt, for ſome director of a tannery, who has employed himſelf in the operations which this art requires, long before the queſtion was propoſed; or for ſome philoſopher, who, for a length of time, has made the art of tanning the object of his experiments. I conſequently did not ſend this memoir to the Academy of Lyons, but conſidering that thoſe which are honoured with the prize are not publiſhed by the academy, and that the authors, contented with

having

having obtained that honour, very often permit theſe valuable works to be withheld from the public; conſidering alſo, on the other hand, that my labours may be of ſome uſe, I thought it my duty to offer them at the Academy of Turin, which employs itſelf ſo ſucceſsfully in the uſeful ſciences, and receives, with great indulgence, every thing relative to them. It may make whatever uſe it pleaſes of this memoir; I ſhall be ſatisfied if it approves my labours, and ſtill more ſo, if any of its members ſhall have the goodneſs to afford me his aſſiſtance in the more careful inveſtigation, which I propoſe to make, of the art of tanning, if my employments ſhould permit me.

FIRST SECTION,

On the nature of tanned leather, the methods employed for tanning it, and the effects which reſult from them.

The ſkin of animals (comprehending under that name all the common integuments) conſiſts of the *Epidermis*, the *Rete mucoſum*, the ſkin, properly ſo called,

called, the *panniculus carnofus*, and the cellular membrane.

Without entering into an anatomical defcription of thefe different ingredients, it is fufficient to take notice, that they all adhere to one another by their furfaces, which are in contact, in the order above mentioned; that the *Epidermis* appears to be formed by the exudation and exficcation of the juices of the *Rete mucofum* *, which is fituated immediately below it; and that, by fibres which pafs through the *Rete mucofum*, it adheres to the fkin, properly fo called; that the *Rete mucofum*, which is under the *Epidermis*, refembling a net-work, is foft to the touch, of a mucilaginous or vifcous nature, and compofed of two layers; that the fkin, properly fo called, forms a membrane compofed of a multitude of fibres, very clofely united among themfelves, directed every way, and formed by the extremity of numberlefs veffels, nerves, and tendons; that the glands, the febaceous follicles, and the roots of the hair, are fituated on the in-

* Haller's Phyfiology, l. 12. f. 1. § 5.

ternal

ternal ſurface of the ſkin; that the cellular membrane is an aſſemblage of a great number of membranous *laminæ*, joined together at different intervals, in ſuch manner as to form interſtices of different ſizes, in which the fat is depoſited *; that between the cellular membrane and the ſkin there exiſts, in quadrupeds, the *panniculus carnoſus*, a ſpecies of muſcular membrane, the uſe of which is to contract the ſkin, and which conſequently adheres ſtrongly to it in certain places †; that, excepting the *Epidermis* and the *Rete mucoſum*, all the other membranes which form the ſkin are traverſed by arteries and veins, which carry blood to them, and bring it back again; that the extremities of the arteries, and the pores of their coats, pour into the cellular membrane a ſerous fluid, which contains lymph, fat, and animal jelly; that as the ſkin of an adult animal has greater thickneſs and extent than that of a young one, it is certain that it grows, in all its dimenſions, with the animal, and that it conſequently derives its nou-

* Monro's Anatomy, vol. II. p. 10—20.

† Haller's Phyſiology, ibid.

tiſhment

riſhment and increaſe from the ſubſtances which the veſſels paſſing through it depoſe thereon.

From this ſhort expoſition of the ſtructure of the ſkin, and of the fluids which are carried into it, and which contribute to its nouriſhment and its growth, it appears that we might ſuppoſe that the analyſis of the ſkins of animals would afford lymph, animal jelly, fat, an extractive matter, ſalts, and fibrous part of the blood, the particular nature of which has been remarked by M. Thouvenel, although, by the too ſhort deſcriptions of M. Fourcroy, we might doubt whether there is in the ſkin any other ſubſtance but the animal jelly. It is according to my ſyſtem of analyſis, if I may be permitted to make uſe of that expreſſion, that I proceeded in making the following experiments.

Experiment I. Fourteen ounces of the ſkin of a cow recently killed, and of which the hair had been ſhaved off very clean, were put into water at the temperature of twelve degrees, (fifty-nine of Fahrenheit,) and, by means of a ſmall iron preſs, placed

placed in the water, and fixed to the bottom of the veſſel which contained it, this ſkin was ſtrongly compreſſed ſix different times, theſe compreſſions being made at the diſtance of an hour from each other; at the laſt the ſkin remained compreſſed during half an hour, and, the water being poured off, the ſkin remained under the preſs.

This water having been expoſed to a gradual heat in a glaſs veſſel, placed upon a ſand-bath, a long time before it boiled there was formed upon its ſurface a reddiſh ſcum, which continued to ſhew itſelf even after the water had boiled a quarter of an hour. Having carefully taken off this ſcum, as faſt as it was formed, and having weighed it, I found it to weigh ſeventeen grains.

Experiment II. The ſkin which was uſed in the preceding experiment, being put into a glaſs veſſel full of water, placed upon a ſand-bath, was ſubmitted to a heat gradually raiſed to ebullition, in which ſtate it continued about ten minutes. As the water grew hot, there was formed upon

 the

the ſurface a very white ſcum, which I took off and drained upon a filtre; when this ſcum ceaſed to riſe, I let the fire go out, and the veſſel cool. As to the ſcum, having weighed it exactly, I found it to weigh twenty-one grains.

Experiment III. When the water uſed in the preceding experiment was cooled to the temperature of the atmoſphere, there was formed at its ſurface a very thin, white, ſlightly-ſcented pellicle, which I knew to be fat: having ſeparated it with the greateſt care, and abſorbed the moiſture by means of filtering paper, I found it to weigh eleven grains.

Experiment IV. I united the water of all the preceding experiments in one glaſs veſſel, which I put into a water-bath. It was of a red colour, and, having evaporated it to dryneſs, I obtained a red reſidue, which had a very ſalt taſte. I poured upon this reſidue half an ounce of alcohol, which, without the aſſiſtance of heat, became of a red colour: I ſeparated it from the remainder of the reſidue from the filtre, and, having evaporated

rated it gently, by a heat which never exceeded thirty degrees, (ninety-nine and a half of Fahrenheit,) I at laſt obtained an extractive animal matter, ſoluble in water, of an agreeable taſte, but rather ſaltiſh, which weighed ſeven grains.

Experiment. V. The remaining part of the reſidue of the preceding experiment, which had not been taken up by the alcohol, by its taſte, its ſolubility in water, and its cryſtalliſation in the form of dendrites, made me ſuppoſe that it conſiſted chiefly of that downy ſalt which M. Thouvenel procured by analyſing muſcular fleſh, but I was not able, any more than himſelf, to make a more particular diſcovery of its nature, on account of its ſmall quantity, as it weighed ſcarcely three grains.

Experiment VI. I now returned to the examination of the other component parts of the ſkin which was uſed in the preceding experiments.

I cut it into ſmall pieces, that it might be got into a matraſs with a long neck, which held about

 nine

nine quarts. I at firſt put in no more than three quarts of water, but I added more thereto, as the firſt evaporated, ſo that I poured in ſucceſſively to the amount of twenty quarts. I covered the mouth of the matraſs with parchment, in which I made only a ſmall hole with a pin, and, the matraſs being placed upon a ſand-bath, I kept the water conſtantly boiling, until nineteen quarts and two thirds were evaporated; ſo that there remained only about a third part of a quart, at the end of the operation. The careful manner in which I proceeded made the operation very tedious; it laſted more than eight days; at the end of which time I poured the water contained in the matraſs, while yet boiling, through a fine cloth, into a glaſs veſſel capable of containing about ſix quarts.

The ſmall pieces of ſkin remained upon the cloth; the *epidermis*, and the cellular membrane, were ſeparated from it in the form of little follicles; the *panniculus carnoſus* ſtill adhered to the ſkin, but very weakly, and was ſeparated from it by the leaſt touch; the ſkin, properly ſo called,

called, was hard and horny, but neverthelefs a little vifcous.

I poured four quarts of boiling water upon this refidue, which I then preffed out very ftrongly: the water which had run into the glafs veffel, was put to evaporate in a water-bath. It contained the animal jelly, which, after being expofed to the fire thirty-fix hours, was fixed into a yellow tranfparent glue. Having taken it out of the veffel as carefully as I poffibly could, I weighed it, and found it to weigh nine ounces, one drachm, feventeen grains.

Experiment VII. The fragments of the fkin, which were left upon the cloth, were exceedingly diminifhed in their fize by drying; the follicles of the *epidermis*, and of the cellular membrane, appeared only in the form of a coarfe powder; the fibres of the *panniculus carnofus* were rather more perceptible, but detached from each other; the fkin, properly fo called, was fhrunk, and rolled up like little cornets. I picked out thefe cornets, of which

which I was able to collect only four drachms twenty-ſeven grains: the remainder of what was left upon the cloth weighed one drachm, two grains.

Some of the cornets formed by the ſhrinking of the ſkin, properly ſo called, being expoſed to the action of a naked fire, contracted very much while they burnt; others, which did not burn, but which were ſtrongly heated, became harder and more brittle than wood. None of them would diſſolve in boiling water; nor were they able to colour it; thoſe which had been expoſed to its action remained hard and brittle. Vegetable alkali, diſſolved in ten times its weight of water, extracted nothing from them.

Collecting together all the products of the preceding experiments, it follows, that a piece of cow's ſkin, recently taken from the animal, and weighing fourteen ounces, gave,

Red

	oz.	dr.	gr.
Red ſcum, - - - -	[illegible]	[illegible]	17
White ſcum, - - -	0	0	21
Fat, - - - -	0	0	11
Extractive matter, - -	0	0	7
Salt, - - - -	0	0	3
Animal jelly, - - -	9	1	17
Fibrous matter, - -	0	4	27
Follicles, being the remains of the cellular membrane, the *panniculus carnoſus*, and the *epidermis*, -	0	1	2
Total	9	7	33

There is conſequently a loſs of four ounces thirty-nine grains, which muſt be attributed to the watery principle originally united with all theſe products, and which was ſeparated from them by evaporation.

By attentively conſidering all the effects obſerved in the preceding experiments, it appears that we may conclude from them, firſt, that the ſcum, or red lymph, was furniſhed not only by the muſcular

muſcular fibres of the *panniculus carnoſus*, but alſo by a ſmall quantity of blood remaining in the veſſels proper to the ſkin: ſecondly, that the white ſcum, or albuginous matter, was principally furniſhed by the cellular membrane, in which the lymphatic arteries terminate: thirdly, that the fat was produced from the interſtices of the cellular membrane: fourthly, that the extractive matter, and the ſalt, were furniſhed by the *panniculus carnoſus*: fifthly, that the ſame *panniculus carnoſus*, and all the other membranes, gave the animal jelly, particularly the ſkin, properly ſo called, and the *rete mucoſum*, which is between the *epidermis* and the ſkin: ſixthly, and laſtly, that the ſkin, properly ſo called, after having been exhauſted of the forementioned juices, was nothing more than fibrous matter.

But, as the art of tanning preſerves no part of a green hide, but the *epidermis* and the ſkin, properly ſo called, it appeared to me of conſequence to examine, whether, in a tanned hide, any ſubſtance was preſerved beſides the fibrous matter.

TO BE CONTINUED IN OUR NEXT.

REPERTORY
OF
ARTS AND MANUFACTURES.

NUMBER IV.

XXXIV. Specification of the Patent granted to Mr. JAMES WATT, of Glasgow, (now of Birmingham,) Engineer; for his method of lessening the Consumption of Steam and Fuel in Fire-Engines.

Dated Jan. 5, 1769.

The usual Term of fourteen Years was afterwards extended, by Act of Parliament, to twenty-five Years, from November 29, 1774.

TO all to whom these presents shall come, &c. Now KNOW YE, that my method of lessening the consumption of steam, and consequently fuel, in fire-engines, consists of the following principles:

First, that vessel in which the powers of steam are to be employed, to work the engine which is called *the cylinder* in common fire-engines, and which I call *the steam-vessel*, must, during the whole time the engine is at work, be kept as hot as the steam that enters it; first, by inclosing it in a case of wood, or any other materials that transmit heat slowly; secondly, by surrounding it with steam, or other heated bodies; and, thirdly, by suffering neither water, nor any other substance colder than the steam, to enter or touch it during that time. Secondly, in engines that are to be worked wholly or partially by condensation of steam, the steam is to be condensed in vessels distinct from the steam-vessels, or cylinders, although occasionally communicating with them; these vessels I call *condensers*; and, whilst the engines are working, these condensers ought at least to be kept as cold as the air in the neighbourhood of the engines, by application of water, or other cold bodies. Thirdly, whatever air or other elastic vapour is not condensed by the cold of the condenser, and may impede the working of the engine, is to be drawn out of the steam-vessels, or condensers, by means

of

of pumps, wrought by the engines themſelves, or otherwiſe. Fourthly, I intend, in many caſes, to employ the expanſive force of ſteam to preſs on the piſtons, or whatever may be uſed inſtead of them, in the ſame manner as the preſſure of the atmoſphere is now employed in common fire-engines: in caſes where cold water cannot be had in plenty, the engines may be wrought by this force of ſteam on[illegible] diſcharging the ſteam into the open air after it has done its office *. Fifthly, where motions round an axis are required, I make the ſteam-veſſels in form of hollow rings, or circular channels, with proper inlets and outlets for the ſteam, mounted on horizontal axles, like the wheels of a water-mill; within them are placed a number of valves, that ſuffer any body to go round the channel in one direction only; in theſe ſteam-veſſels are placed weights, ſo fitted to them as entirely to fill up a part or portion of their channels, yet rendered capable of moving freely

* This ſhould not be underſtood to extend to any engine where the water to be raiſed enters the ſteam-veſſel itſelf, or any veſſel having an open communication with it.

in

in them, by the means herein-after mentioned or ſpecified. When the ſteam is admitted in theſe engines, between theſe weights and the valves, it acts equally on both, ſo as to raiſe the weight to one ſide of the wheel, and, by the re-action on the valves, ſucceſſively, to give a circular motion to the wheel, the valves opening in the direction in which the weights are preſſed, but not in the contrary; as the ſteam-veſſel revolves round, it is ſupplied with ſteam from the boiler, and that which has performed its office may either be diſcharged by means of condenſers, or into the open air. Sixthly, I intend, in ſome caſes, to apply a degree of cold, not capable of reducing the ſteam to water, but of contracting it conſiderably, ſo that the engines ſhall be worked by the alternate expanſion and contraction of the ſteam. Laſtly, inſtead of uſing water to render the piſton or other parts of the engines air and ſteam tight, I employ oils, wax, roſinous bodies, fat of animals, quickſilver, and other metals, in their fluid ſtate. In witneſs whereof, &c.

XXXV.

XXXV. Specification of the Patent granted to Charles Gower, of Oriel College, Oxford, M. A. for his Method of depurating and improving Animal Oil.

Dated April 5, 1792.

To all to whom these presents shall come, &c. Now know ye that, in compliance with the said proviso, I the said Charles Gower do hereby declare, that my said invention is described in manner following; that is to say, the coarser animal oils are ever liable to chill on the approach of cold weather, owing to the superabundant water of the gelatinous substance they contain. Gelatinous substances which are prepared from the mucous parts of animals, in the same manner as true mucilage is prepared from vegetable matter, are highly soluble in water, but are considerably aided in the solubility by acids, and by alkalis. Acids are somewhat preferable to alkalis, as attacking the true gelatinous parts only, whereas the alkali is apt

to

to attack the oil alſo, and with it to form a ſoapy coagulum, rendering the combination too ſtrong to obtain the oil pure, and by itſelf, by any de-compoſition. The above are the principles on which this patent is chiefly founded; and the pro-ceſs whereby theſe principles are put in practice is as follows. Take any quantity of oil, and about an equal quantity of water that has been previ-ouſly acidified, (any acid will do, but vitriolic acid will be the cheapeſt,) or, if the alkaline proceſs be preferred, lime-water will come the cheapeſt. Put theſe quantities of oil, and acidified or alkali-zate water, into any kind of receptacle or utenſil, in which a perfect admixture of their parts may take place. The moſt convenient mode of ad-mixture ſeems to be by the repeated revolution of a barrel, in which daſhes have been placed, ſome-what reſembling a barrel-churn. This churn, as it may be now called, can be turned by fire, wa-ter, air, or the power of draught animals, or other mechanical powers, and may be ſo varied in its forms, and ſo differently conſtructed, as to admit of no preciſe deſcription; nor is any attempt made here at ſecuring the invention of the churn, it be-

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ing of very old date, and deſcribed only for the purpoſe of ſhewing how, and by what modes, an admixture of theſe fluids might be made the more conveniently to take place. A very few revolutions will be ſufficient to unite the fluids together; when this is effected, the liquor is to be paſſed from the churn into the pans, made of any convenient and fit materials, in order that the ſolution of the gelatinous parts may go on, and the water ſubſide to the bottom of the pan. The oil is now to be drawn off by a cock, placed juſt above the water, which may eaſily be done, becauſe of the water and oil being in equal proportions, or nearly ſo; the cock muſt be placed half way, provided the utenſil or pan be an equal-ſided figure. As a manufacture of this ſort is likely to be carried on at all ſeaſons of the year, and as the degrees of heat on the thermometer differ according to the changes in the ſeaſon, it will be adviſable to have each pan placed within another, about four inches or more from the ſides of each, upon the principle of a water-bath; by lighting a fire in a grate placed under the pan, the water in the outer pan is heated, and adminiſters heat to the oil and wa-

ter

ter in the inner pan, aiding the ſolution of the gelatinous matter by its warmth, and clarifying the oil from the chill it had previouſly undergone. If the oil be turbid, or contain any ropy matter, or ſtraws, ſticks, &c. then proceed as follows: put an equal quantity of oil and fair pure water together into the churn, give them a few revolutions, and add to them a ſufficient quantity of freſh yeaſt, or any other ſubſtance capable of exciting an inteſtine motion and fermentation; convey it from the churn into the pan, and let the whole, by the heat of the water-bath, be brought to ferment. The feculences will ſubſide, and the oil float on the top. Draw off the clear oil. In witneſs whereof, &c.

XXXVI. Specification of the Patent granted to Mr. JAMES BAYLEY, of the Pariſh of St. Leonard, Shoreditch, Dyer; for his Invention of a Machine for dying, ſtaining, or printing Handkerchiefs, and other Articles.

Dated Nov. 28, 1792.

TO all to whom theſe preſents ſhall come, &c. NOW KNOW YE, that, in compliance with the ſaid proviſo, I the ſaid James Bayley do hereby declare, that my ſaid invention is deſcribed in manner following; that is to ſay, the common method of preparing handkerchiefs, &c. which are to be dyed with ſpots left of the original colour, is by binding thread tight round a ſmall part, the ſize of the ſpot required, in places previouſly printed with the deſigned pattern, which prevents the dye from colouring thoſe places ſo tied. I have

have invented a mode of preſerving any parts of handkerchiefs, &c. from the dye, without any previous preparation, by means of frames, upon the faces of which are ſmall blocks, projecting in ſuch a manner as, when the face of one frame is put upon the face of another frame, the blocks are all exactly oppoſite, and correſponding with each other, ſo that an handkerchief, or other article to be dyed, being put between, and the frames faſtened together, the dye will have acceſs to every part of it, excepting thoſe places which come between the blocks, which are preſerved, of the original colour of the article, from the effects of the dye. Theſe frames are flat ſurfaces of wood, braſs, copper, or other metals, or compoſition, of any ſize or ſhape, and may have one face with blocks, to be uſed with or againſt one face without blocks. The blocks may either be parts of the ſame ſurface, left projecting, by being cut out of the ſolid, or may be made ſeparately of wood, braſs, copper, or other metals, or compoſition, and faſtened upon the ſurfaces of frames, or may be part put on, and part left projecting off the frames. They are not confined to any particular figure, but are of any ſhape,

ſhape, with the faces, or tops of the blocks, plain, or having devices on them for admitting the dye to parts of the block, or may have a hole drilled in each, from the ſide down to, and through, the face or top, to admit the dye to form a ſpot, or other device, cut in the face or top. The frames are prevented ſhifting on each other by means of holes or plates with holes faſtened on one, and correſponding pins in the other frame, uſually called ſteady pins and plates. Frames are thus put together to any number, according to the length of the article to be dyed, and are faſtened together with planks on both ſides, with ſcrews and nuts at each end of the planks; on the frames are faſtened handles, for raiſing them in and out of the copper, &c. by means of pulleys. In witneſs whereof, &c.

XXXVII. Deſcription of a Patent Machine for combing Wool; communicated by the Patentee, the Rev. Edmund Cartwright, of Doncaſter, Yorkſhire.

WITH A PLATE.

THIS machine is, I believe, the firſt of the kind; at leaſt, all former attempts (if there have been any) muſt have proved abortive; as, previous to my invention, no wool was ever known to have been combed any other way than by the ſlow and expenſive proceſs of hand-labour.

The magnitude of this invention, in reſpect of its object, and its importance to the woollen manufactures, may, in ſome degree, be eſtimated by the quantity of combing wool annually grown in this iſland, which, according to the moſt approved calculations, cannot be leſs than 3 or 400,000 packs; the average expence of combing which by hand may reaſonably be laid at £800,000, or a million. That this calculation is not far from the truth, we need only recollect that the body of

wool-

wool-combers is ſuppoſed to be nearly 50,000, among whom the alarm which the introduction of this machine has occaſioned is well known. Upwards of forty petitions, from various parts of the kingdom, were preſented to parliament, during the courſe of the preſent ſeſſions, for its ſuppreſſion: and, for this purpoſe, a bill was brought into the Houſe of Commons by the friends of the petitioners. It was, however, rejected by a great majority; indeed, had the principle of the bill been admitted, there had been an end to all manufacturing improvements. But, ſetting even this conſideration aſide, on other principles of policy it would have been inadmiſſible; even on the principle of humanity to the petitioners, the only ground on which it could be defended, there is reaſon to believe it would not have been neceſſary. The introduction of new inventions or improvements, whatever may be their value, being in general ſo gradual as to effect thoſe, whoſe occupations they interfere with, almoſt imperceptibly.

I obtained my firſt patent, for this important invention, on the 27th of April, 1790. In conſequence

quence of ſome additional improvements, I obtained a ſecond patent on the 11th of December, in the ſame year. But it was not till nearly two years afterwards, that my machine was brought to its preſent ſtate of ſimplicity and perfection, when I took out a third patent, dated May 15, 1792.

The wool, if for particular fine work, goes through three operations, otherwiſe two are ſufficient: the firſt operation opens the wool, and makes it connect together into a rough ſliver, but does not clear it. The clearing is performed by the ſecond, and, if neceſſary, a third operation. A ſet of machinery, conſiſting of three machines, will require the attendance of an overlooker and ten children, and will comb a pack, or 240lb. in twelve hours. As neither fire nor oil is neceſſary for machine-combing, the ſaving of thoſe articles, even the fire alone, will, in general, pay the wages of the overlooker and children; ſo that the actual ſaving to the manufacturer is the *whole* of what the combing coſts, by the old imperfect mode of hand-combing. Machine-combed wool is better, eſpecially for machine-ſpinning, by at leaſt 12 *per*

cent.

cent. being all equally mixed, and the ſlivers uniform, and of any required length. On the firſt introduction of this machinery, it was found, when not carefully attended, to produce a greater proportion of noil and pinion than good hand-combing; but, in its preſent improved ſtate, it makes much leſs than any hand-combing whatever.

The advantages of machine-combing ariſe not merely from the ſaving of expence; yarn ſpun from it has a decided ſuperiority, eſpecially for curious purpoſes, ſuch as ſuperfine hoſiery, &c. At Meſſrs. Daviſon and Hawkeſly's mill, in the neighbourhood of Nottingham, where this machinery is made uſe of, yarn is ſpun of a quality which it was thought no mill-ſpinning could ever have arrived at. In juſtice, however, to the ſpirit and ingenuity of thoſe gentlemen, it muſt be added, that their ſpinning machinery is ſuppoſed to be upon a very ſuperior conſtruction. Beſides the above mill, my invention is already introduced into many others, and, in all probability, as trade revives on the reſtoration of peace, will be univerſally adopted.

What

What follows is the ſpecification of this invention, in its improved ſtate, taken from the different patents; rejecting ſuch particulars as, by the ſubſtitution of improvements ſince the date of the firſt patent, have been ſuperſeded and laid aſide.

Fig. I. (Plate XIV.) The crank laſher.

A. A tube through which the material, being formed into a ſliver, and ſlightly twiſted, is drawn forward by the delivering rollers. B. A wheel faſt upon the croſs-bar of the crank. C. A wheel, on the oppoſite end of whoſe axis is a pinion working in a wheel upon the axis of one of the delivering rollers.

Note. When two or more ſlivers are required, the cans or baſkets, in which they are contained, are placed upon a table under the laſher, (as repreſented at D,) which, by having a ſlow motion, twiſts them together as they go up.

Fig. II. The circular clearing comb, for giving work in the head, carried in a frame by two cranks.

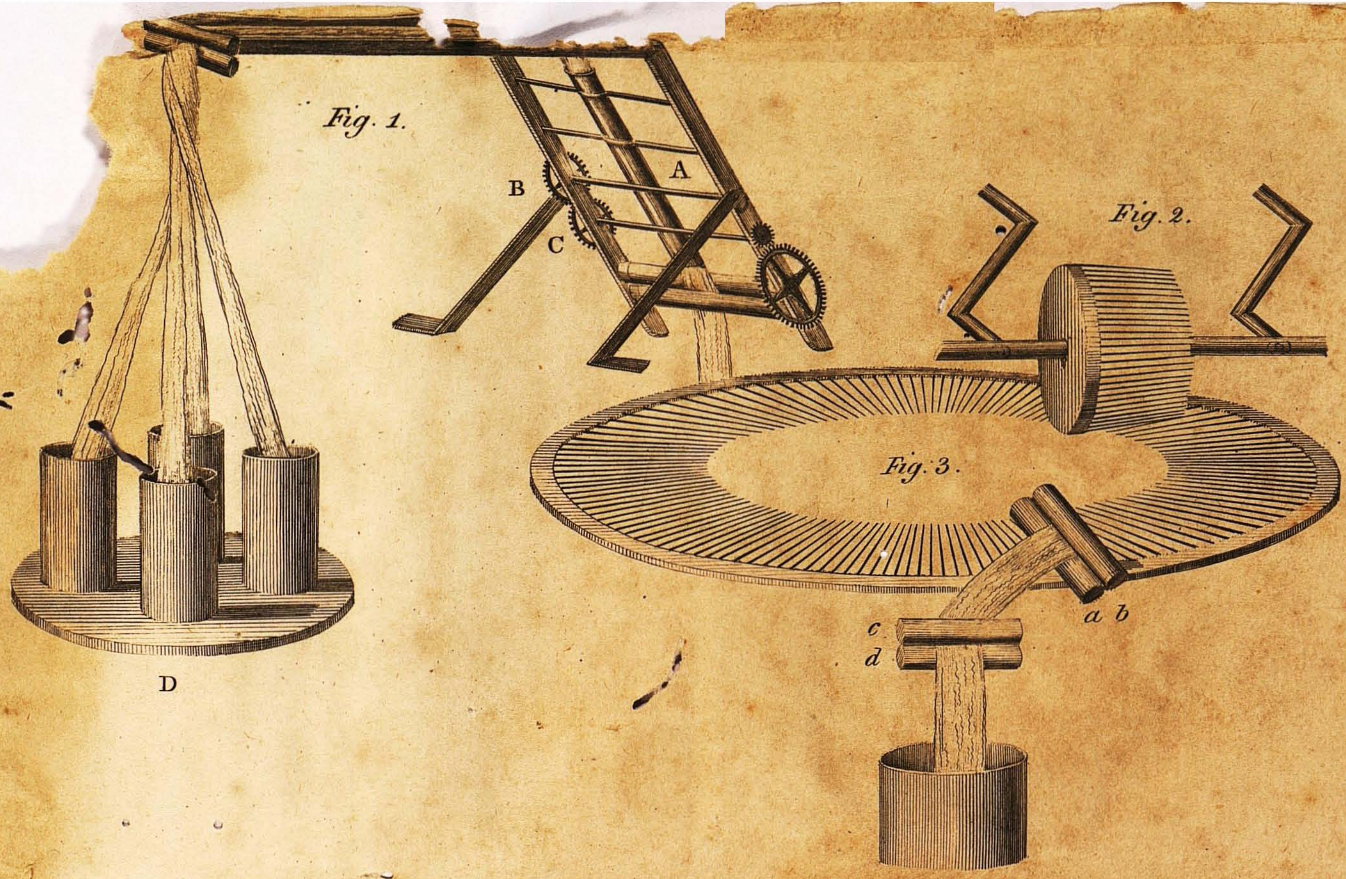


Fig. 1.
A
B
C
D
Fig. 2.
Fig. 3.
a b
c
d

Fig. III. The comb-table, having the teeth pointing towards the centre, moved by cogs upon the rim, and carried round upon trucks, like the head of a windmill.

a. b. The drawing rollers. *c. d.* Callender, or conducting rollers.

Note. Underneath the table is another pair of rollers, for drawing out the backings.

It is to be obſerved, that the machine which firſt operates upon the wool differs in ſome points from the preceding, but not ſo materially as to require a particular deſcription of it, and, as this deſcription would require an engraving to accompany it, it is omitted.

In the above ſpecification we have omitted the frame in which the machine ſtands, the wheels, ſhafts, &c. Had theſe been introduced, the drawing would have been crowded and confuſed; beſides, as matters of information, they would have been unneceſſary, every mechanic, when he knows the principles of a machine, being competent to apply the movements to it.

XXXVIII. Obſervations on making Butter, and on keeping Milch-Cows in the Houſe.

From the general View of the Agriculture of the County of Mid Lothian; drawn up, for the Conſideration of the Board of Agriculture, by GEORGE ROBERTSON, of Grantham, near Edinburgh.

IN Mid Lothian the dairy is conducted on a ſmall ſcale, yet, as a deſcription of the practice common there may have its uſe, the following authentic ſtatements of it are ſubjoined.

Caſe I. A gentlewoman in the vicinity of Edinburgh, who has been much accuſtomed to the management of a dairy, ſtates, that ſhe has been always uſed to churn the whole milk in a plunge churn with a ſwee, (a lever applied to the end of the churn-ſtaff,) which ſhe thinks is much preferable,

able, on account of its greatly facilitating the operation. In warm weather the milk is fit for churning in forty-eight hours, keeping it from the churn till it is cool; but, in cold weather, it muſt be put in warm, to make it thicken ſooner; for it is not fit to be churned till it is thick, and in great cold it is even neceſſary to ſet it in a warm place, to promote the coagulation, as the ſooner this is accompliſhed both the butter and the butter-milk are the better. When the milk is long kept, it contracts a diſagreeable rancid taſte, on which account chiefly ſhe prefers churning the whole milk; for, in making butter from cream, the milk muſt be kept long, in order to obtain all the cream from it. But whether churning milk or cream be moſt profitable is not yet aſcertained in this neighbourhood; though it is held that the milk-butter is moſt palatable, at leaſt will keep much longer ſweet. In warm weather cold water is put in, during the operation of churning; and, in cold weather, boiling water in proportion to the degree of cold; but in temperate weather none at all. It generally takes from one to two hours to churn, but that depends much on the temperature of the

 milk,

milk, for, if it is either too warm or too cold, it requires a longer time. As to the quantity of butter to be got from milk, it is not eaſily determined, as the milk of cows differs ſo much in quality. It is generally obſerved, however, that the milk of thoſe cows which give moſt is the worſt in quality; but that is not always the caſe, for ſhe has had cows that gave very little milk, and that very bad, and others that gave a great deal, and very good in quality; in particular, one cow that yielded between ſeventeen and eighteen Scotch pints (from eight to nine Engliſh gallons) of milk in a day, and from that quantity ſhe procured two pounds (twenty-two ounces each) of butter, which ſhe thinks is more than the average, for the common computation is about ten or eleven Scotch pints to the pound of butter.

Caſe II. A gentleman who had tried an experiment, in order to know whether it was moſt profitable to churn the whole milk, or only the cream which the milk produces, ſtates, that he had a favourite cow that gave eighteen Scotch pints of milk a day, of a ſeemingly rich quality, from its cream-

cream-like appearance; that he caufed one day's milk to be churned by itfelf, which produced only three-fourths of a pound of butter; that he afterwards caufed the cream of two days milk to be collected, and from that he had three pounds two ounces of butter; from which remarkable difparity he is decidedly of opinion, that it is much more profitable to collect the cream and churn it than to churn the whole milk together. He thinks alfo that cream-butter is much richer than the butter got from the whole milk, which feems indeed to be pretty generally acknowledged. On the other hand, he owns that it will not keep fo long fweet; which arifes, perhaps, from the very circumftance of its being more oleaginous, and thence more apt to corrupt. Refpecting, however, the above experiment, in farther explanation of the circumftances it appears, that the one day's milk was collected from the noon of one day to the morning of the next, then immediately churned; whereas the two days cream was collected on a Thurfday and Friday, and remained to ripen till the Monday following, before it underwent that operation, which may perhaps account, in a great degree, for the difference in the produce.

Cafe

Caſe III. A conſiderable farmer in the neighbourhood of Town, ſtates, that he uſes a patent churn, which holds forty Scotch pints, (twenty gallons Engliſh,) but in which only twenty-four pints can be churned at a time; that it is milk, not cream, that he churns; which is prepared by being put, when warm from the cow, into an earthen pan to cool, and then turned over into a deep wooden veſſel, to remain until it acquires a ſufficient degree of acidity and thickneſs: and, from twenty-four pints of milk, there are commonly three pounds and a half (twenty-two ounces each) of butter, and ſometimes more. He is of opinion, that the butter obtained by this mode of churning is ſomewhat poorer; for this reaſon, that the operation being quicker, and more violent, than in the common plunge churn, (being performed in an hour, whereas the other generally takes two,) it has the effect of producing a greater quantity of butter, leaving the milk quite exhauſted, and very poor in quality; that ſubſtance which might remain amongſt the butter-milk being, by this means, converted into butter, and being the pooreſt part of the compoſition, tends to make

the butter itſelf leſs rich than it would otherwiſe be; although, on the other hand, the quantity he thinks is greatly augmented.

Caſe IV. In my own dairy (if the management of three or four cows deſerves that appellation) the cows are milked in ſummer thrice a day; in the morning, at noon, and in the evening. Each milking is kept by itſelf in flat wooden veſſels, to cool till the next milking, when it is poured into the churn, the ſucceeding milk taking its place in the flat veſſels, to cool it in like manner; and thus in ſucceſſion for two or three days, according to the temperature of the air, the milk thickening, and thence is fit for churning, ſooneſt in the warmeſt weather. The quantity of butter is generally in the proportion of a pound (twenty-two ounces) for each ten pints, or five Engliſh gallons, of milk. In winter the cows are milked only twice a day, and the milk is put into the churn warm from the cow, where it ſtands a day or two longer than in ſummer before it becomes ſufficiently thick; although, to promote the coagulation, it is ſometimes brought near the kitchen fire,

fire, particularly on the preceding night before it is churned; and, in intenſe cold, it becomes alſo neceſſary to add a ſmall quantity of boiling water. The operation of churning is performed with the plunge churn, in from two to three hours for thirty or forty pints of milk; and, at the laſt ſtage of the proceſs, a little cold water thrown in has the effect of promoting the ſeparation of the butter from the milk, and making it adhere more cloſely together. In all the operations it is underſtood to be of great moment to attend to the cleanneſs of the different veſſels employed; they are therefore carefully rinſed from time to time, and endeavoured to be preſerved in all poſſible purity.

It is ſingular that the beſt mode of making butter ſhould not yet have been decidedly aſcertained, and it will probably require a variety of careful experiments, under the direction of the Board of Agriculture, before this important art can be brought to perfection *.

* If a gentle warmth is neceſſary for thickening the milk, perhaps the boilers made of wood, invented at London ſome

years

Before concluding this important ſubject, the attention of the reader is particularly requeſted to the following obſervations, reſpecting the advantages of feeding milch-cows in the houſe, in preference to keeping them out of doors, being the ſubſtance of a paper ſent by Baron d'Alten, an intelligent Hanoverian nobleman, to the Board of Agriculture.

The Baron remarks, that milch-cows are infinitely more profitably kept in the houſe than out of doors, but they muſt be early trained to it, otherwiſe they do not thrive.

The beſt kinds of food for them are clover, lucerne, potatoes, yams, turnips, carrots, honey-graſs, (a German graſs not known in England,) cabbages, peas, and beans.

Such cows as thoſe in the neighbourhood of London, kept in the houſe, and properly fed,

years ago, by a native of Germany, might anſwer the purpoſe. In ſome places a miſerable kind of butter is made from whey, but that practice is not known in Mid Lothian.

ought to yield nine English gallons (eighteen Scotch pints) *per* day, for the first four months after calving. Afterwards the quantity will become less and less.

But on the supposition that such cows yield, at an average, only six gallons for nine months, or two hundred and fifty-two days, that, at 6d. *per* gallon, produces 3s. *per* day, or, in nine months, 37l. 16s.

If from any circumstance the milk cannot be sold fresh, the profit will be much less, but is still very considerable. Each five gallons English (ten Scotch pints) of milk should produce a pound of butter; hence, in all, 302lb. worth, at 1s. *per* pound, 15l. 2s. The butter-milk, for the purpose of fattening swine, should be worth 7l. 11s. Total 22l. 13s.

An English acre, of a middling soil, should produce 20,000lb. weight of green, or 5,000lb. of dry, clover.

A large

A large cow requires 110lb. of green, or 27½lb. of dry clover *per* day, consequently in 365 days 40,150lb. or a trifle more than the produce of two acres. Whereas the ſame cow, fed entirely out of doors, ſummer and winter, would require a paſture of four acres; the ground would be injured by being poached with her feet; the graſs hurt by being bruiſed inſtead of cut; and the manure would not be half ſo uſeful.

According to the firſt calculation, each acre ſhould produce in milk 18l. 18s.; and, by the ſecond, (in butter and butter-milk,) 11l. 6s. 6d. beſides the value of the manure.

It has been found that currying cows fed within doors, and keeping them as cleanly as horſes in a ſtable, are attended with the beſt conſequences, both in regard to the milk they yield, and the rapid improvement of the cows themſelves.

XXXIX. Deſcription of a proportional Scale, for reducing Plans, Maps, &c. by Mr. JAMES BAYLEY, of Shoreditch.

WITH A PLATE.

From the TRANSACTIONS of the SOCIETY for the Encouragement of ARTS, MANUFACTURES, and COMMERCE.

A Bounty of Ten Guineas was given to Mr. BAYLEY for this Invention.

THIS inſtrument conſiſts of two flat braſs limbs, of unequal lengths, turning upon a centre-pin A, (ſee Plate XV. Fig. 1.) which is fixed upon a braſs box, filled with lead, B, having three points at the bottom, to keep it firmly fixed to the table: a nut ſcrews on at the top of the centre-pin, to keep the braſs limbs ſteady.

The longer limb C D is in length, from the centre A, twenty-eight inches one quarter, and is graduated

graduated into inches, and tenths of inches; the ſhorter limb E F, which is nineteen inches and a half long, has on it four or more ſcales of inches, divided into ſmaller parts, as fifteenths, twentieths, twenty-fifths, thirtieths, &c. An index G moves on this limb, having a ſpring, with a projecting point underneath, connected with it.

To make uſe of the inſtrument, turn the plan you wiſh to reduce bottom-upwards, (as the inſtrument inverts it in the reducing,) and, bringing the graduated edge of the longer limb to any angular or remarkable point of the plan, &c. obſerve what diviſion it coincides with, and ſet the index on the ſhorter limb to the correſponding diviſion on that ſcale you wiſh to reduce it to; then, putting your fair paper underneath, make a point upon it, by preſſing the ſpring with your thumb; then again move the longer limb, till ſome other angular point, or other remarkable part, coincides with its graduated edge; and, obſerving the diviſion again, move the index to the ſame diviſion on the ſcale, and make a point as before.

In

In this manner proceed till all the angular or remarkable points are thus transferred to the fair copy, which may afterwards be joined by right or other lines.

It is obvious that every angular point muſt be taken; and, the greater the number of other remarkable points that are transferred, the more correct your plan will be.

XL. Deſcription of a Nail and Bolt Drawer; by Mr. WILLIAM RICH, of Yalding, Kent.

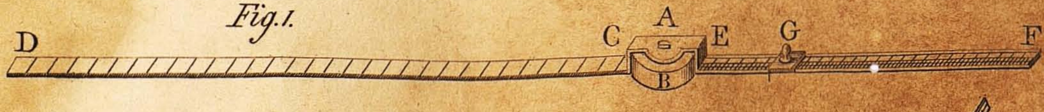
WITH A PLATE.

From the TRANSACTIONS of the SOCIETY for the Encouragement of ARTS, MANUFACTURES, and COMMERCE.

A Bounty of Three Guineas was given to Mr. RICH, for this Invention.

THE annexed plate and deſcription will ſhew the form of this tool, which has been found of con-

Fig. 1.



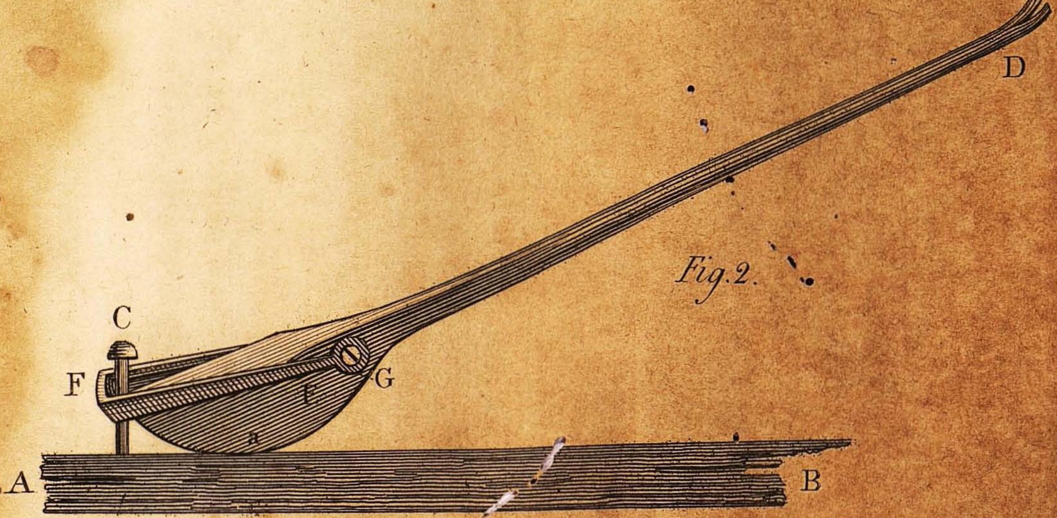


Fig. 2.

confiderable ufe to workmen concerned in breaking up fhips, and in other employments where large nails or fpikes have been ftrongly driven into wood, and it has become neceffary to extract them.

Plate XV. Fig. 2. reprefents the nail-drawer in the action of extracting a fpike; where A B fhews the piece of timber, C the nail or fpike to be drawn, D E the fhape of the tool, confifting of a lever D, moving on a folid part, in form of the fegment of a circle, at E; a fquare ftaple F turns on a centre at G, and the fpike to be drawn being held between the end of the lever and the ftaple, any preffure at D acts with an effect proportional to the diftance *a* F and D *a*, and confequently enables the workman to exert a very great force againft the fpike C.

XLI. A Treatiſe on Saltpetre; by JAMES MASSEY, Eſq.

From the MEMOIRS of the LITERARY and PHILOSOPHICAL SOCIETY of MANCHESTER.

THE great importance of ſaltpetre, ſince the invention of gunpowder, is too well known to be here expatiated upon, as well as the numerous rewards that have been offered to thoſe who ſhould give us the cleareſt and beſt account of it: a ſure ſign that, notwithſtanding it has been long made in very conſiderable quantities in almoſt every part of Europe, our knowledge of this ſalt is ſtill very imperfect.

This induced the author of the following pages, many years ago, to turn his attention to this ſubject; and he flatters himſelf that, by long obſervation, and a practice which, though not very extenſive, may have been ſufficient for this purpoſe, he has made ſuch diſcoveries as may render

the business of saltpetre-making no less easy and familiar to his countrymen than it has long been to our neighbours upon the continent.

He never, indeed, could be brought to believe, that it was owing to any defect in our climate, or to the want of materials, that we have so often failed in our attempts this way, but merely to our inattention to some particular points in the practical part, upon which our success, in a great measure, depended. These, therefore, he has principally laboured to explore, and to set them in so strong a light, that they can no longer escape our observation.

It is the custom of the saltpetre-makers abroad to wait till the earths they have procured, or prepared for this purpose, are fit to answer their end: a practice which, we have reason to think, has rarely been followed by our countrymen; who, finding the earths they have employed imperfect upon the first trial, have seldom afforded them a second; and thus have rejected many that, in a

due courſe of time, might have anſwered their moſt ſanguine expectations.

They have, likewiſe, not duly attended to the large quantities of earth that our neighbours are obliged to elixiviate, in order to obtain a ſmall portion of ſaltpetre; and, finding their portion but trifling, in the trials they have made, have too haſtily concluded this buſineſs to be ſcarcely worth following; when, had they reflected upon the great number of ſaltpetre-makers in France and Germany, they muſt certainly have enter-tained a very different opinion.

But what has chiefly diſcouraged us, we pre-ſume, may have been our ignorance of the true grounds and principles upon which the practice of making ſaltpetre is founded; which, we may obſerve, have never been clearly laid open. All that we are told is, that ſaltpetre is extracted from the rubbiſh of old houſes, the bottoms of ſtinking pits and ditches, and the like; which has induced many perſons to conclude, that this ſalt is gene-

rated

rated in theſe earths: whereas the truth is, that nothing is extracted from theſe earths but a peculiar acid, which, in conjunction with the fixt ſalt of wood-aſhes, and not without, forms this neutral one, which cryſtalliſes in the ley when boiled down as above-mentioned; which circumſtances being omitted, it can be no wonder that we are led into very great errors.

Of this acid, the ſource from which it is derived, and the manner in which theſe and other earths become impregnated with it, we ſhall endeavour to give the moſt full and ſatisfactory account, as well as of the practical methods of making ſaltpetre; all which might be compriſed in a page or two, had we not a variety of chimeras to encounter, and this practice particularly to explain. By theſe means we hope to remove all that myſtery and obſcurity, in which this ſubject has been ſo long involved; and to render the practice of making ſaltpetre as eaſy and familiar to the Engliſh as it has long been to the French and Germans, ſo much to the advantage of thoſe nations.

The great uſe of ſaltpetre, in the compoſition of gunpowder, has long rendered it an object of the firſt importance; upon which account the learned have ſpared no pains to obtain the moſt perfect knowledge of it, but hitherto, as it ſeems, without ſucceſs, as no clear and ſatisfactory account has yet been given of it. And, though the methods of making it in France, Germany, and many other parts of the world, have been minutely deſcribed, theſe deſcriptions, through ſome defect or other, have been of little ſervice to us, if we may judge from the many fruitleſs attempts to make this ſalt in England.

The common accounts that are given us of nitre, or ſaltpetre, are, indeed, ſo very vague and various as rather to confuſe and perplex than give us any clear knowledge of it. Some will have it to be a production of nature, others entirely of art. Some tell us it is drawn from the air; others, that it is extracted from vegetables and animals. We are told too, that it is found upon the ſurface of the earth, and upon old walls in the form of hoar-froſt, and that whole provinces are ſometimes covered

covered over with it; all which is certainly very falſe and fallacious, if by ſaltpetre, in this place, is meant the ſaline concrete which is of ſo much uſe in the compoſition abovementioned, and which, though ſometimes found in the walks of nature, is moſt aſſuredly, in general, a production of art.

Saltpetre, to give a juſt deſcription of it, is a neutral ſaline concrete, evidently formed by the combination of a peculiar acid, with a fixt vegetable alcaline ſalt. This acid is found in certain earths, from which it is extracted by elixiviating them along with wood-aſhes; the fixt ſalt of which, uniting with the acid, forms this neutral one, which cryſtalliſes in the ley, when boiled down to a due conſiſtence.

From this plain account of the formation of ſaltpetre, it muſt be obvious, that it can no where be found without the concurrence of theſe two principles: and conſequently not in the air, nor in vegetables or animals, becauſe, though this peculiar acid may, perhaps, be found in theſe ſubjects, the fixt ſalt muſt needs be wanting.

That

That it may ſometimes be found in the earth, we ſhall not deny, owing to the accidental introduction of wood-aſhes to a ſoil impregnated with this acid: and that it may thence paſs into the ſtems and apices of ſome plants, with the moiſture that enters their roots, is far from being inprobable; but that whole provinces can ever be covered over with it, or that it can be generated in theſe organiſed bodies, as Lemeri and ſome others have imagined, muſt exceed all belief.

The accounts which travellers generally give of this ſalt are, that it is extracted from the ſoil of the countries they have viſited, by elixiviating it with water, and evaporating the fluid; which, we believe, may be conſiſtent with truth; but here it ſhould not be forgotten, that a certain portion of wood-aſhes is always added to this ſoil before it is elixiviated, a circumſtance which, either through ignorance or inattention, they have too often omitted to mention. We are told, indeed, by Mr. Bowles, that, in ſome parts of Spain, they have an earth that yields the cryſtals of this ſalt, without any aſſiſtance of this kind; and in

such quantities as might ſupply all Europe with this article. But, till the fact is better authenticated, we have many reaſons to doubt the truth of it.

Be this as it may, we ſhall here judge it of more uſe to advert to thoſe earths that are well known, with the aſſiſtance of wood-aſhes, to yield us the cryſtals of this ſalt; to point out their peculiar quality, and the ſource from which it is derived; together with the true reaſon why they are not always in a condition to yield us theſe cryſtals, even with the addition of a fixt ſalt; a circumſtance that has much perplexed the moſt experienced ſaltpetre-makers. After which nothing, we truſt, will remain, but to lay down the practical methods of making it, ſupported by the beſt authorities, as well as our own experience.

Of theſe earths, the moſt diſtinguiſhed are, the rubbiſh of old houſes, the ruin of old vaults and cellars, &c. which rarely fail to yield us the cryſtals of this ſalt, when elixiviated with wood-aſhes. That theſe earths poſſeſs an acid quality is not to be

be diſputed; ſeeing that, upon reducing them to a coarſe powder, and percolating a fixt alkaline ſolution through them, this ſolution will be neutraliſed, and no longer yield us an alkaline but a neutral ſalt.

From what ſource this acid is derived is at preſent unknown. The moſt general opinion is, that it is drawn from the air; but to this there are many objections. In the firſt place, the aërial or univerſal acid is generally allowed to be not of the nitrous but vitriolic kind. And, ſecondly, there are many earths impregnated with this acid, which, in all appearance, have had no communication with the air, of which the ſoil at the bottoms of graves is a flagrant inſtance.

From the well-known fact, that the rubbiſh of all ſuch houſes as have been occupied by the filthieſt inhabitants, and that of ſuch clay-walls as have ſtood in he neighbourhood of dunghills, or wherever putrid vapours more plentifully abound, are always moſt ſtrongly impregnated with this acid, it is moſt natural to believe, that theſe vapours

muſt

must confer it upon them, and, consequently, that it must have its origin in putrid substances; but to this there are likewise many objections. In the first place; the recent juices of vegetables and animals, some few of the former excepted, if we are not mistaken, contain no kind of acid whatever, and in a putrid state every body knows they are of a volatile alkaline nature; which objection, being the most powerful, we shall here principally endeavour to remove, and, upon the whole, shall undertake to shew, that there is an original acid in all vegetables and animals, which, being rendered volatile by putrefaction, assumes the specific character of the nitrous. And that, since this acid constantly arises in vapour from putrid substances, hence it is, that the rubbish of old houses, and that of old clay-walls, become impregnated with it, as well as those earths that lie in conjunction with them.

That the recent juices of vegetables and animals are, in general, perfectly neutral, we shall readily admit: but hence we think it does not follow, that they contain neither an *acid* nor *alkali*, as is commonly

commonly concluded; on the contrary, we apprehend a more juſt inference is, that being *mixt* they muſt neceſſarily contain *both*. It is certain, that if we throw a calcareous earth, or fixt ſalt, into any one of theſe juices, the earth or ſalt will be neutralized by it; which we take to be a proof that it contains an acid which quits the weaker to join with the ſtronger alkali, according to the law of affinities.

And the caſe will be the ſame if theſe juices are putrefied. If we throw a fixed ſalt into any putrid liquor, it will be neutralized by it; and now, if we dip a piece of ſoft paper into this mixture and dry it, it will dry like a match, in the ſame manner as if dipped into a weak ſolution of ſaltpetre. Which ſhews, that it not only contains an acid, but one of the *nitrous* ſort; and, provided this liquor were perfectly putrefied, and the marine ſalt, with which all nitrous leys greatly abound, carefully removed, we cannot help thinking that, upon being boiled to a due conſiſtence, it would yield cryſtals of ſaltpetre. The author muſt acknowledge he has boiled down many of theſe mixtures without ſucceſs;

cess; but it was at a time when he was ignorant of the necessity of attending to the above circumstances.

That all putrid substances, and consequently their juices, are of a volatile alkaline nature, is not to be denied; owing to an union of their acid and oily parts with their earth, which is equally subtilized by the putrid process. But that the two former are safely separated from the latter, by adding a calcareous earth, or fixt salt, to them, the meanest chemist can tell us; the earthy or alkaline part flying off, and leaving the acid and oily ones combined with the earth or salt, with which they have a greater affinity. And that thus calcareous earths, by lying in conjunction with putrid matters, become possessed of a *volatile acid, oily mixt*, which is Stahl's precise description of the nitrous acid, must be clear to conviction.

TO BE CONTINUED IN OUR NEXT.

XLII. Conclufion of Mr. BERTHOLLET's Method of bleaching Cloths and Thread.

(FROM P. 202.)

IF, at prefent, when the oxygenated muriatic acid cofts nearly three *deniers* (about half an English farthing) a quart in the provinces which are not fubject to the *gabelle*, the new method of bleaching, when properly conducted, is frequently advantageous notwithftanding this expence; it is not to be doubted but that it may become much more fo, by means of thefe œconomical practices which I have juft now mentioned. But, fo long as the preparation of the bleaching liquor is at all expenfive, there will always be a great advantage in favour of fine cloths; becaufe, in equal quantities of furface, they prefent a lefs quantity of matter, and are bleached much eafier; fo that an ell, or a pound, of fine cloth, requires much lefs liquor than an ell, or a pound, of coarfer cloth.

 But

But, that the advantages of this procefs may be fully enjoyed, it is neceffary to eftablifh it in a country which is not fubject to the tax on falt, called the *gabelle*; for, where falt is not at a low price, the oxygenated muriatic acid becomes too expenfive *.

Neverthelefs, it is not by the expence of the new procefs, rigoroufly compared with that of the ordinary method of bleaching, that we muft judge of its advantages, as it is attended with fome particular ones which would compenfate a fuperior price. Cloths and thread, which in fome places require many months, may be eafily bleached in five or fix days, even in a large manufactory; and the bleaching of a few pieces only may, without difficulty,

* The *Bureau d'encouragement* at Rouen has already propofed to mix with the falt, which fhould be fold at a low price for bleaching, one pound of green vitriol to the hundred weight. The falt, by this mixture, acquires a colour which eafily diftinguifhes it, and a tafte which does not permit it to be ufed fraudently. The methods by which the purity of the falt may be re-eftablifhed are too expenfive to occafion any abufe: to thefe might be joined infpection, and other methods of fecurity, fo as to take away every fear of fraud.

difficulty, be terminated in two or three days. Befides, the new method of bleaching may be executed in the winter as well as in the fummer, only the drying requires more time.

An induftrious countryman, whofe family employ their intervals of leifure in fpinning, is obliged to wait for favourable weather, and perhaps to fend his thread and cloths to a great diftance, where they remain a long time in bleaching; or, if his neceffities are preffing, he is obliged to fell them, at a lofs, to fome intermediate factor, who lays a tax upon his poverty. But, if the manufactories for making oxygenated muriatic acid increafe in number fufficiently, thofe who weave a piece of cloth will be able to bleach it themfelves, and to enjoy the whole fruit of their labour as foon as it is out of their hands.

The warehoufeman, in a feafon which is unfavourable to the ordinary method of bleaching, is not able to fulfil his engagements without great difficulties; he is obliged to employ a confiderable capital to fill his warehoufe in the feafon in which

which the bleaching is executed; he is frequently unable to enter upon ſpeculations which might lead to profit, (by his taking advantage of opportunities which unexpectedly offer themſelves,) becauſe it would require too much time to bleach the quantity of cloths which he may want.

The conſumer will alſo find his advantage, as there will not only, in the end, reſult ſome diminution in the price of cloths and thread, but the new bleaching, when properly executed, diminiſhes the original ſtrength of flax and hemp much leſs than the long and often-repeated operations of common bleaching.) It even appears, by the experiments of M. Decroiſille, that the oxygenated muriatic acid, by contracting the pores of cotton, gives it more ſolidity, and alſo communicates to it the property of taking more brilliant colours.

As the cloths are leſs worn, an apparent diſadvantage ariſes, in the eyes of ſome dealers, from this new method; which is, that they do not appear ſo fine as cloths of the ſame quality bleached in the common manner. M. Bonjour has even been

been obliged to contrive methods of wearing the cloths which had been bleached in the manufactory which he directs. It is evident that such methods are not difficult to be found; but those who are willing to give up this apparent fineness, will, of course, have their cloths of greater strength.

Besides, may not those vast meadows, which in very fertile countries are taken up with cloths, (which it is necessary to keep spread over them all the fine weather,) be gained for the purposes of agriculture, to which they are now almost lost?

If I do not deceive myself, the process which I have described ought to be distinguished from those which merely contribute to the progress of the arts; it deserves to be warmly patronized by those whose duty it is to watch over the public prosperity, as, besides its advantage to commerce, it may directly contribute to improve the country, which, being the primary source of our riches, has the strongest claim to our attention.

I shall

I ſhall now proceed to deſcribe ſome other uſes, which the oxygenated muriatic acid may be employed. It appears that it may be ſucceſsfully made uſe of to deſtroy the madder-ground of printed cloths. When theſe cloths are printed with different corroſives, they are paſſed through the madder-bath, where the deſigns take different ſhades, according to the nature of the corroſives, but at the ſame time the ground of theſe cloths takes the colour of the madder: this colour, which is much leſs permanent than that which has been fixed by the corroſives, it is neceſſary to deſtroy by means of cow-dung, and bran, and by long expoſure in the fields. When I firſt tried, inſtead of theſe means, to uſe the oxygenated muriatic acid, I found that the colours, which ought to be preſerved, were themſelves much injured.

But Mr. Henry, of Mancheſter, an able chemiſt, found that mild alkalies, either vegetable or mineral, prevented this bad effect of the liquor, and he has ſince that time uſed it with ſucceſs; I am not acquainted with the particulars of the method which he follows. M. Decroiſille wrote to me,

nearly about the fame time, that he had made the fame obfervation, and I foon after was convinced of the truth of it, by making ufe of the process which I defcribed when fpeaking of the javelle ley, namely, by weakening, with a great deal of water, the liquor thereby obtained. M. Oberkampf, to whom I communicated this procefs, and who neglects nothing which may contribute to the perfection of his excellent manufactory at Jouy, immediately began to make fome trials, which he has lately continued with M. Royer, and which promife to be fuccefsful, except with refpect to colours in which iron has been employed; for, thofe are weakened; the reds, on the contrary, become brighter than by the ordinary procefs; but my knowledge of this art is not yet fufficiently perfect to enable me to be more particular *.

* It appears, from what I have juft learnt from Mr. Taylor, a celebrated manufacturer at Manchefter, where they begin to make ufe of the new method, that there is not always a neceffity for adding alkali to the oxygenated muriatic acid; and that the colours which contain iron are not always weakened. Thefe different effects probably depend upon the various methods ufed in printing the cloths.

In

In the trials made at Jouy, the expence has been greater than that of the ordinary proceſs, on account of the price of ſalt; this is a great diſadvantage to manufactories of printed cloths eſtabliſhed in countries ſubject to a tax on ſalt.

It probably will be of more advantage in reſpect to printing cloths than bleaching them, to be able to determine the comparative ſtrength of the liquors; but the ſolution of indigo cannot be employed for this purpoſe, as (according to an obſervation made by Mr. Watt, and communicated to me) it only loſes its colour imperfectly when there is any alkali in the liquor; on the contrary, the ſolution of cochineal perfectly anſwers the purpoſe.

Mr. Henry and M. Decroiſille have alſo obſerved, that we may ſucceſsfully employ the liquor compounded of oxygenated muriatic acid and alkali, to heighten the colour of cotton which has been dyed of the Turkey red.

I have already ſhewn that we may, by means of oxygenated muriatic acid, bleach the green ve-

 getable

getable wax; I have not, indeed, been able give it a whitenefs equal to that which the common wax takes, but it retained only a flight yellownefs, and was rendered very fimilar, in its other properties, to common wax. I had alfo found that yellow wax might be bleached by the fame means; but I was obliged to melt the wax, and repeat the operation feveral times, in order to bleach it perfectly, and I judged that the expences would be too great, to allow us to fubftitute this procefs to that which is now ufed. The Chevalier Landriani wrote to me, that Baron Born had found that yellow wax was very well bleached, by being expofed to the vapour of oxygenated muriatic acid, and that he intended to form an eftablifhment for this method of bleaching it. Here the ufe of this vapour is not attended with thofe inconveniences which I mentioned in refpect to cloths, and I think it not improbable that an advantageous ufe may be made of this procefs.

•

I mentioned, in my former memoirs, that this liquor might be made ufe of to try the durability of colours, and to fhew in a few moments what

change

ınge and length of time would produce therein. great number of experiments have convinced that it poſſeſſes this property, and I have fou d as yet but very few exceptions; I even believe that we ſhall never be deceived, if we put into the liquor (as an object of compariſon) a ſpecimen of the ſame colour, of the goodneſs of which we are aſſured.

Mr. Hauſſman, of Colmar, has found, as I have heard from Baron Dietrich, that any kind of colour in cloth may be deſtroyed by means of the oxygenated muriatic acid, if we afterwards put it into a weak ſolution of vitriolic acid, to diſſolve the metallic parts which are in many dyes. Nevertheleſs, it muſt be obſerved, (and this is a property of which we may alſo make advantage,) that the oxygenated muriatic acid gives to animal ſubſtances a yellow colour, as may be ſeen in the courſe of my experiments upon the ſulphureous acid. I am therefore inclined to believe that Mr Hauſſman's method is chiefly applicable to vegetable ſubſtances.

EXPLA-

EXPLANATION OF THE PLATES.

(See Plate XVI. and XVII.)

Figure I. Elevation of the apparatus for preparing oxygenated muriatic acid. In which is reprefented a reverberatory furnace A B C D, having, on a line with B, many fmall openings in its circumference, to ferve as chimneys; within which, upon a fand-bath *a*, is placed a matrafs *b*, the neck of which ftands out above the furnace, running through the opening D, which is to be clofed with clay. The mouth F, of the neck of the matrafs, is clofed by a cork G, through the middle of which paffes a tube H, which forms a communication between the infide of the matrafs *b*, and the intermediate veffel K, where it alfo paffes through a cork I, which clofes one of the three openings of that veffel. The corks G and I ought to be prepared before-hand, and well fitted to each end of the tube of communication H, which is to be fo difpofed that it may be fitted in immediately after the mixture is made in the matrafs.

The

The intermediate veſſel K is about an eighth part full of water; into it is plunged the tube of ſafety L, to prevent danger from regurgitation. The tube ought to be ſo high, that the weight of the water which enters into it, by the preſſure of the gas, may be great enough to cauſe the gas to paſs into the pneumatic tub N O P, by the tube of communication M, which is plunged therein, and reaches to the bottom, where it is bent horizontally, ſo that the gas may be emitted under the firſt of the three wooden, or (if they can be procured) ſtone-ware, cavities, or receivers, which are placed in the inſide of the tub, one above the other. O is a handle which ſerves to turn the agitator E, the movement of which facilitates the combination of the gas with the water. P is a ſpigot and faucet to draw off the liquor.

Figure II. Upper part of the pneumatic tub. In which Q R S T are four ſtaves which are thicker than the others, and which project within the tub, when they are hollowed ſo as to receive the ends of two wooden bars UV, which ſerve to keep in their places the cavities or receivers X.

Figure III. Section of the tub. Each cavi[ty] X is ſo conſtructed that it may receive the gas which is emitted at *i* from the tube of commun[i]cation M. The gas, as it comes out, is collec[ted] under the loweſt cavity, and increaſes in qua[n]tity until it paſſes by the funnel Z to that in the middle, and afterwards to the upper one. The opening through which the agitator E paſſes, in the centre of each cavity, is in the ſhape of a funnel, and is ſo formed as to hinder the gas from eſcaping along the agitator, which is furniſhed with three tranſverſe arms *c*, each being faſtened by a wedge *d*; *e f* repreſents one of theſe arms in a horizontal direction.

The bent tube *g h* ſerves to draw off the atmoſpheric air which is contained under the cavities, after the tub has been filled with water. To make uſe of this tub, the bent part is ſucceſſively introduced under each cavity, as is ſhewn at *g*; we muſt then blow into it, at the end *h*, till the water in it is forced out: after which the air contained under the cavity will immediately make its eſcape.

Figure

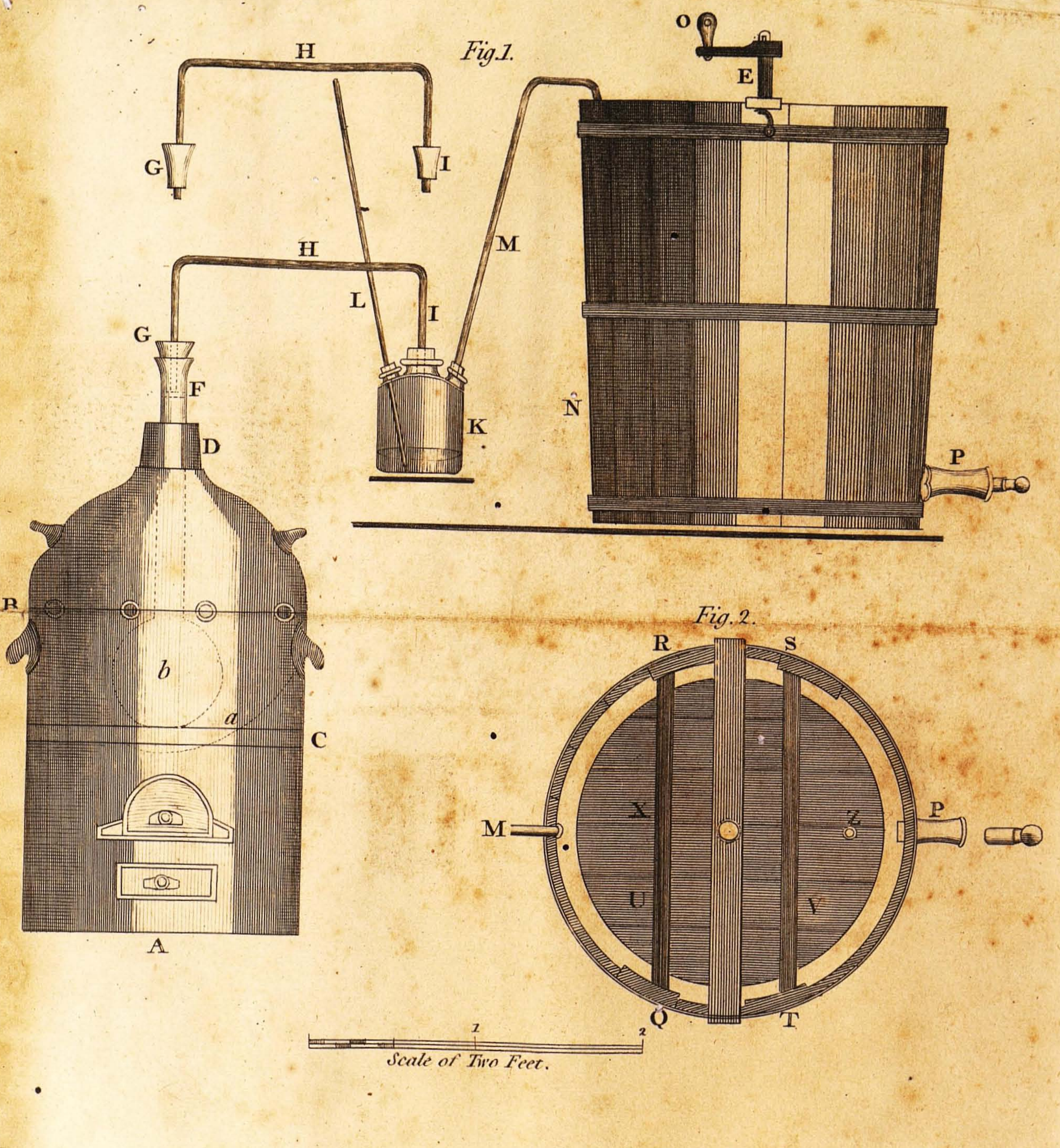


Fig. 1.
H
G
I
H
L
I
G
F
D
M
K
N
O
E
P
B
b
a
C
A
Fig. 2.
R
S
X
Z
M
P
U
V
Q
T
1
2
Scale of Two Feet.

Fig. 3.

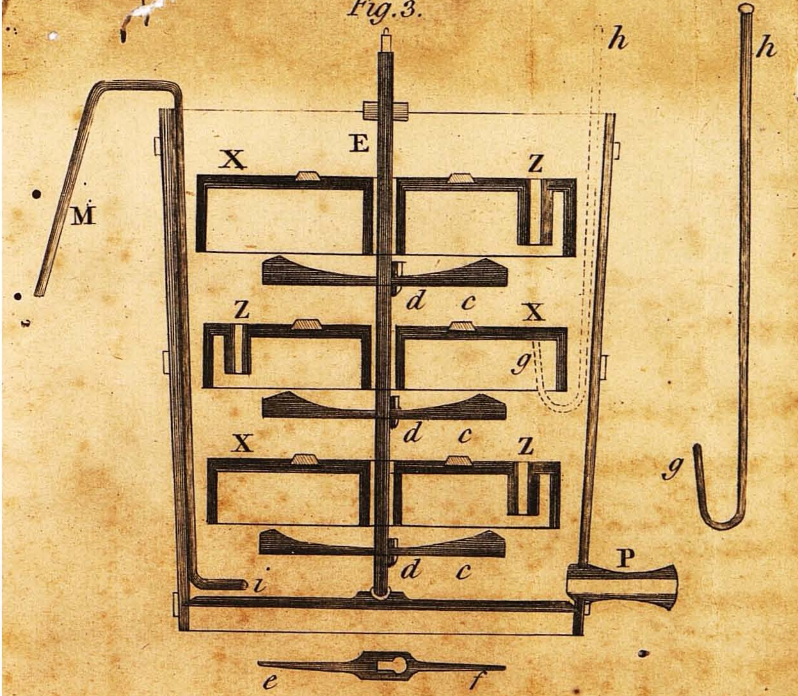


Fig. 4.

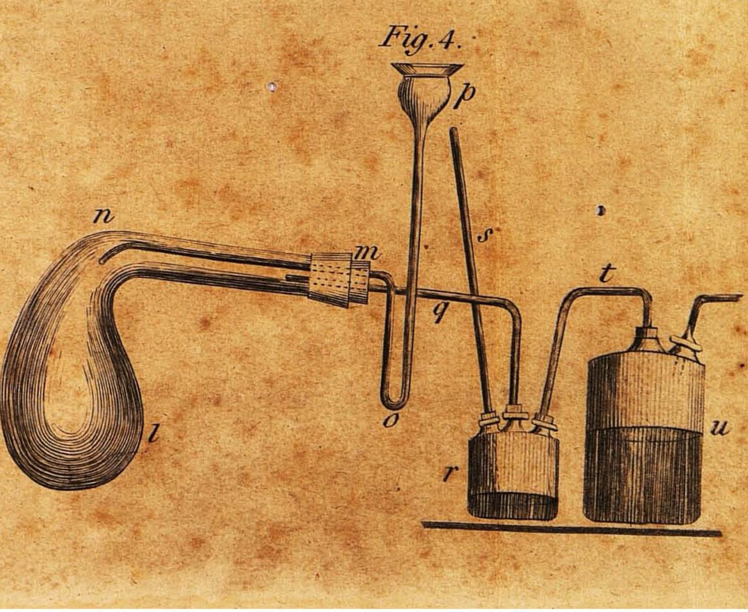


Figure IV. Apparatus for the diſtillation of common muriatic acid. In which *l* repreſents a retort, which is to be placed in a reverberatory furnace; the mouth of the retort is to be cloſed by a cork *m*, having two holes, through one of which paſſes the tube *n*, bent at *o*, and terminating at the top in the form of a funnel *p*, by means of which the vitriolic acid is to be introduced into the retort. The other hole of the cork *m* receives the end of a tube *q*, which forms a communication between the retort and a veſſel *r*; which veſſel has three openings, and is to be about an eighth part full of water, into which is to be plunged the tube of ſafety *s*, to prevent danger from regurgitation: the veſſel *r* has a communication with a ſecond veſſel *u*, by means of the tube *t*: this ſecond veſſel is to be half full of water, and is to have a communication with a third; this third veſſel ſhould be alſo provided with a tube of ſafety, and is to communicate with a fourth.

XLIII. Continuation of the Chevalier de St. Real's Memoir on rendering Leather impermeable to Water.

(FROM p. 216.)

EXPERIMENT VIII. I cut into narrow ſlips ſome ſtrong cow-leather, fit for making ſoles of boots; I threw them into cold water, where I let them ſoak for ſeventy-two hours; after which I boiled them in the ſame water, to which I added more as faſt as it evaporated. So that, during twelve ſucceſſive hours, four ounces of leather were boiled in forty ounces of water, after having been previouſly ſoaked therein for ſeventy-two hours. At the end of this long proceſs, I took the leather out of the water, which I put aſide.

Theſe ſlips were diminiſhed in all their dimenſions, they were become harder and more brittle than wood; when broke, the broken part appeared fibrous, and of a deep brown colour. The water in which they were boiled was very red; I evaporated it to dryneſs in a glaſs veſſel, placed in a

water-bath: it did not, towards the end of the operation, become more viſcous, nor did it form a jelly by cooling. The reſidue, which weighed nine grains, was brown, ſoluble in water, and, with a ſolution of green vitriol, gave a black precipitate.

It appears to me to follow, from this experiment, that tanned leather contains neither fat, nor lymph, nor animal jelly; and, although we might ſuppoſe the reſidue of the water in which it was boiled to be extractive matter, yet the property which this reſidue poſſeſſes, of precipitating the iron from a ſolution of vitriol, of a black colour, makes me rather think that it is nothing but tan, or the extract of tan, which had inſinuated itſelf, by means of the water in the pits, into the pores of the leather, and which had been fixed therein by the evaporation of the water, when the leather was dried, after being taken out of the pits. Every body knows that tan is formed from the bark of trees, particularly from that of oak and fir; and it is equally well known that theſe barks contain, in abundance, the aſtringent principle, called, by the French, gallic acid.

To ſhew that the gallic acid combines with the leather, in the operation of tanning, it is ſufficient to moiſten it with a ſolution of green vitriol; we then ſee, almoſt inſtantaneouſly, the part that is touched become of a fine black colour. Indeed this combination is very ſtrong, for the leather, after being ſoaked in water many days, and even boiled in it for a long time, does not loſe the gallic acid which was united with it; the leather uſed in the preceding experiment, after ſeventy-two hours immerſion, and twelve hours boiling, in water, was ſtill turned black by being wetted with a ſolution of green vitriol.

The preceding experiments enable us to define and diſtinguiſh between a green hide and a tanned one. The firſt is a ſimple animal matter, containing many organic parts and principles, which do not exiſt in the ſecond. This latter is no other than the ſkin, properly ſo called, of the firſt, covered with the *epidermis*, and combined with the gallic acid; it is, in fact, a vegeto-animal ſubſtance. This difference of their principles produces the difference of their properties; the green hide

hide left to itſelf is ſuſceptible of fermentation, and paſſes from the acid fermentation to the putrid, in a very ſhort time. Tanned leather, on the contrary, when left to itſelf, is incorruptible, and is not altered, even by a long continuance in water; the green hide, on account of the lymph it contains, is, in ſome degree, ſoluble in cold water, and, on account of its animal jelly, is in great part ſoluble in hot weather. If tanned leather is acted on by water, it is in the manner of a ſponge, whereas the green hide has an affinity with it.

To bring a green hide into the ſtate of tanned leather, it is neceſſary to ſeparate from it the cellular membrane, the *panniculus carnoſus*, and the *rete mucoſum*, and alſo all thoſe principles which are ſoluble in water, and capable of fermentation; afterwards to ſaturate that part which remains (or the fibrous matter of the ſkin) with the aſtringent principles of the tan, or gallic acid. Such is the object of the tanner's art, and it muſt be allowed that there is, in all its principles, a wonderful combination of means to arrive at the deſired end; which is the more aſtoniſhing as the art is arrived

to

to a ſtate of great perfection, without the help of the ſciences, the tanner having no clear ideas of the nature of the matter upon which he acts, or of the phyſical properties of the agents which he employs. We ſhall form a better judgement of this, by a ſhort deſcription of the principal operations of this important art; an enquiry which cannot be improper, as it is neceſſary to appreciate the merit of the different methods made uſe of.

There are three methods uſually employed for preparing the hides, all of them known in France and elſewhere; but the tanners who uſe any one of them have no deſire to adopt, or even to examine, the others, being generally perſuaded that the beſt method is that they themſelves employ. The firſt, the moſt ancient, and the moſt general, is that which is done by means of lime; the ſecond is that in which barley is made uſe of; and the third is performed with a ſour infuſion of old tan, and called *à la juſée*. All three are deſcribed in the art of tanning, by M. de la Lande. Theſe three methods have ſome proceſſes which are common to all, and others which are particular to each. I ſhall

ſhall begin with an explanation of the operations which are common to all, the waſhing, the paring, and the tanning.

The firſt object of the tanner, according to the before-mentioned experiments, and the principles reſulting from them, ſhould be to deprive the ſkins of the blood and other humours which are ſoluble in water, and capable of fermentation, and which are left in them in the veins and extremities of the arteries. (Theſe ſubſtances are uſeleſs to tanned leather, and would, before the operation of tanning was finiſhed, be apt to make the ſkins putrefy.) The art of tanning fulfils this object by the waſhing. The green hides, or ſalted ſkins, are left to ſoak in water for a longer or ſhorter time, according as they are more or leſs dry; they are taken out of the water, from time to time, to ſtretch them upon the horſe, or beam, where the ſurface is preſſed with a round knife; they are then forcibly wrung, and afterwards ſoaked until they are again filled with water, or till there is reaſon to fear putrefaction would take place.

The

The whole of this proceſs ſeems to be proper, it perfectly fulfils the object which the tanner propoſes, and without doubt after ſuch an operation the ſkins can no longer retain either blood, ſeroſity, or lymph. There is but one remark of any importance to make upon this operation; namely, that the ſkins run the hazard of fermenting, and putrefying, if they are left to ſoak in ſtanding water. All theſe operations ſhould therefore be executed in running water, and it is alſo to be wiſhed that each ſkin ſhould be placed by itſelf. By this we ſhould avoid the danger of ſand being interpoſed between the *laminæ* of the cellular membrane, which would produce a number of angular wedges, which might tear the ſkin while ſtretching upon the horſe; and we ſhould alſo avoid a greater danger, viz. that of two ſkins adhering by their viſcoſity, which, in hot weather, might, in a very few hours, give riſe to putrefaction.

When the ſkins have been well waſhed, ſoftened, ſmoothed, and ſwelled, by the particular proceſſes whch I ſhall hereafter deſcribe, they are to be pared; that is to ſay, the cellular membrane, and the

the *panniculus carnoſus*, are to be ſeparated from them. In fact, theſe two operations are equally important; the cellular membrane is a very ſpongy ſubſtance, and adheres too ſlightly to be preſerved; the *panniculus carnoſus* does not exiſt in every part, and is of an unequal thickneſs, which would hinder it from being of any ſervice in many of the different uſes to which leather is applied; beſides, its adherence to the ſkin is not ſufficiently ſtrong for it to reſiſt the operations of tanning and currying. As to the manner of executing the operation of paring, the ſkin is to be ſtretched upon the horſe, and the workman, being furniſhed with an iron inſtrument with a turned edge, draws it over the ſkin, holding it as parallel as poſſible thereto, and thus takes off the cellular membrane and the *panniculus carnoſus*, the attachment of which, by the preceding operations, is become very ſlight.

It does not appear neceſſary to make any particular remark upon this operation, which does not require, on the part of the workman, any thing but practice, and a proper attention not to cut the ſkin, properly ſo called.

When the hides have undergone the preceding operations, and are ſufficiently ſwelled, they are put into the tan. In fact, it would be more tedious and more expenſive to put them into the tan without being ſwelled, as they would contain a large quantity of animal jelly, which the tan would indeed take away, but with difficulty; beſides, as the tan, on account of its aſtringent principle, produces a contraction, the leather would of courſe become hard and brittle. Nothing, therefore, is more evident than that the hides ſhould be dilated as much as poſſible, without deſtroying them, before they are ſubmitted to the action of the tan. The object of tanning, ſtrictly ſpeaking, is to contract the fibres of the leather, and thus to give it conſiſtence. This is brought about by means of an aſtringent ſubſtance, called of late by the name of gallic acid, and contained in the bark of trees, eſpecially in that of young oaks and fir. For this purpoſe theſe barks are reduced into powder, which is ſprinkled over the hides; at the bottom of a pit this powder is put ſix inches deep, upon which a hide is ſpread, and upon this hide, according to the thickneſs of it, two or three

inches

inches more of the powder; upon this another hide, and ſo on. When the pit is filled, it is finiſhed at top with ſix or ſeven inches in height of old bark, which has already been uſed in tanning. Planks are placed upon the pit, which are frequently loaded with ſtones, that the bark may be more cloſely applied to the hides which it is intended to impregnate. The pit then has clean water poured into it, which it imbibes by degrees, and care is taken to keep it always well ſoaked. This operation is three times repeated upon thick hides, uſing every time freſh powder. The ſpace of time, from the firſt to the ſecond operation, is three months; from the ſecond to the third, four months; and, at the laſt, the hides are left five months in the pit.

The experiments which I have deſcribed in the beginning of this paper ſeem to ſhew that the gallic acid is the only principle of the tan which combines with the leather. Allowing this poſition, it appears that the preceding operation would be improved by ſubſtituting freſh bark, in lieu of the old which is put at the bottom and top of the pit.

This old bark cannot have any great power, nay, if it is entirely deprived of its gallic acid, it cannot contribute any thing to the formation of the leather; it may rather be ſaid to retard it, if its effect be compared with the progreſs which would be made if the pit did not contain any thing but freſh bark; and, in an operation of ſo great length as tanning, the return of the capital, and its intereſt, cannot be retarded, without occaſioning a great loſs to the proprietors. Beſides, old tan is more apt to ferment than new bark, and, of courſe, to cauſe the hides which lie above it to ferment alſo, which would certainly diminiſh their goodneſs. It cannot, therefore, be from a principle of œconomy that old tan is uſed in the pits, ſince its want of power renders it of no effect.

The operations which have been juſt now deſcribed are, as we formerly obſerved, common to all the three methods of preparing leather; but the method of taking off the hair, and that of ſwelling the hides, are various; ſome tanners following one of thoſe about to be deſcribed, and ſome another.

If

If the hides are worked with lime, they do not proceed to take the hair off till after they have been ſoaked in pits into which the lime is thrown, and in ſome places a ley of wood aſhes. When the lime which has ſerved for ſeveral pits is employed for another, it is called a *dead pit*. In theſe dead pits the hides are left two whole months, before the hair is taken off. This is performed by ſtretching the hide upon the horſe, and making uſe of the round knife.

In working hides with barley, a paſte is made of barley-meal, which, after it has grown ſour, is thinned by the addition of water, and the hides are then ſoaked therein. This ſour water produces an acid fermentation in the hides; when this fermentation has looſened the hair, it is taken off upon the horſe. Some tanners prefer the ſpontaneous fermentation of the hides to the method juſt deſcribed. They pile them one upon the other, while they are yet green; the hides ſoon begin to ferment and grow hot, and when the hair appears to be looſe they proceed to take it off.

This

This method is generally followed in thoſe hides that are worked *à la juſée.*

I ſhall now take notice of the manner of dilating the hides, and rendering them fit to be expoſed to the action of the bark. If they are worked with lime, they are, when the hair is taken off, put for four months into a *weak pit*, that is to ſay, into a pit the lime of which has already been uſed. They are then put into a *freſh pit*, that is, one that has never been uſed, the lime of which, conſequently, poſſeſſes its cauſticity undiminiſhed: in this pit they remain for the ſpace of four months; the lime ought to cover the hides intirely. (The brothers Fauvre, at the tannery of Caſelette, near Turin, leave their hides in the lime-pits only forty days in winter, and thirty in ſummer; but they allow more bark, and leave them a longer time in the bark-pits.) Afterwards they are put into another *freſh pit*, in which they remain from two months to four. In theſe pits the hides ſwell, ſoften, and become fit to receive the action of the bark. There are employed in

theſe

these operations thirty-four cubic feet of quick lime for eight cow-hides.

When the hides are worked with barley, they are softened, and swelled, in the acid water before mentioned. They remain in it, at different intervals, about thirty-two days; at the end of which time they are sufficiently prepared for being tanned. The method, called *à la jusée*, is performed by soaking the hides (after taking off the hair, washing, and paring) in a sour infusion of old tan, in which they soften and swell, for the space of twelve days in summer, and twenty-four in winter.

The three methods which I have just described all produce the same effects. These (although the tanner is ignorant of their nature) are to destroy the *rete mucosum*, and to take from the skin, properly so called, all the animal jelly which it may contain, and which, of course, by rendering the skin less compact, disposes it to dilate by the action of water. It appears to me, however, that all these operations are attended with more or less danger. Lime, it is true, is a powerful solvent of

of animal jelly, but it is to be feared that it may injure the fibrous part of the ſkin; and, if we may believe M. de la Lande, leather prepared without it is of a ſuperior quality. Moreover, the operation is very long, and retards, more than any other, the return of the proprietors capital. Fermentation, which is the baſis of the two other methods, is alſo not without danger; if continued a little longer than it ought to be, it is to be feared that it may produce a putrefaction of the fibrous parts; but theſe two methods have both of them the great advantage of being ſhorter than the firſt; and that called *à la juſée* is much leſs expenſive.

Before I mention thoſe methods of reforming and improving the art of tanning, which my reflections, and the preceding experiments, have ſuggeſted to me, it is neceſſary to deſcribe the reſult of two other experiments.

TO BE CONTINUED IN OUR NEXT.

REPERTORY

OF

ARTS AND MANUFACTURES.

NUMBER V.

Printed by JOHN NICHOLS, Red-Lion-Paſſage, Fleet-Street, London.

XLIV. Specification of the Patent granted to Mr. GEORGE STRATTON, of Cheapſide, London; for his improved Kitchen-Range or Stove, with an Apparatus to prevent Smoky Chimneys.

WITH TWO PLATES.

Dated May 7, 1794.

TO all to whom theſe preſents ſhall come, &c. NOW KNOW YE that, in compliance with the ſaid proviſo, I the ſaid George Stratton do hereby declare, that the nature of this invention is an improvement upon fire-places, by which very great heat may be derived from a very ſmall fire, by means

means of a flue, or flues, connected immediately with the fronts, the ſides, the back, and, if neceſſary, the bottom of ſuch fire-places, or with any one of them, as well as with the top; it contains alſo a contrivance for immediately extinguiſhing fire in chimneys, as will be hereafter particularly ſhewn. Fig. 1. (Plate XVIII.) is a front view of the range, &c. fixed in a chimney. AA are the fronts upon the right and left hand ſide of the fire-place. B is the grate or fire-place. CC is a plate which lies flat upon, and intirely covers over, the top. D is a door in the plate immediately over the fire-place. EFG and HH are regiſters, or dampers. I is a blower, ſuſpended to the top plate: and there may be a plate at the bottom, which will ſerve as a hearth-plate, upon which the machine or ſtove may ſtand. Fig. 2. (Plate XVIII.) is another front view of a range, &c. fixed in a chimney, with the fronts (Fig. 1.) opened to ſhew the front flues. KK is brick-work, which when the doors are ſhut is fluſh with the edge of the front flues, or a boiler or boilers, or an oven or ovens, or iron, or ſtone, or any other proper material, may be uſed to

fill

fill the ſpace inſtead of brickwork. L L are flues, proceeding from the top of each cheek, underneath the top plate, to the chimney. M M is the inſide of the fronts A A, (Fig. 1.) 1 2 3 4 5 6 are the flues. Fig. 3. (Plate XIX.) is a front view of the backs, and of the two cheeks, of the grate or fire-place, O is the back, and P P are the right and left hand cheeks. N is an aperture in the back, and R R, S S S, T T T, are apertures in the cheeks. This machine, or ſtove, may be made of wrought or caſt iron, or of any other metal or compoſition of metals, or of ſtone, or brickwork, or any other natural or artificial production that may be eligible, or parts of one ſubſtance and parts of another; its ſhape may be ſquare, circular, ſemicircular, elliptical, or any other equally or more convenient; and the ſize of the whole proportioned to the chimney, or place in which it is intended to ſtand; and the ſize of the parts proportioned to the whole. If it is intended to be fixed as in the drawing, and the width of the whole ſtove to be four feet, each front may be nineteen inches, and the fire-place ten inches, or any other proportion may be uſed according to the quantity of

 heat

heat required. Inftead of carrying the fmoke and hot air, &c. directly up the chimney, as ufual, they are by this invention carried through the apertures in the cheeks R R, (Fig. 3.) to the flues LL, (Fig. 2.) underneath the hot plate; and likewife through the apertures SSS, TTT, (Fig. 3.) to the flues 1 2 3 4 5 6, (Fig. 2.) and thence through 8 8, along the fides, and then into the chimney by a flue or flues in the moft convenient place; or may be continued along the fides, turn at 9 9, (Fig. 2.) pafs along the back, and thence into the chimney, by a flue or flues in the moft convenient place; or, after paffing the fronts, be carried down the fides, along flues underneath the bottom, afterwards up the back, and into the chimney, by a flue or flues in the moft convenient place, or in any other way the workman may prefer: fo that thefe flues may be carried over the whole, or part, of the infides of the fronts, fides, back, and, if neceffary, underneath the bottom, as well as the top, by curvilinear flues, or any other that may be eligible. In the drawing there are fix flues; but, if more eligible, the fame fpace may be divided into more or lefs than

fix,

fix, or it may contain only one. The partitions, forming the flues 1 2 3 4 5 6, may be riveted to, or caſt on, the fronts, ſides, back, and, if neceſſary, the bottom as well as the top, or formed by any other proper materials, in any other eligible mode. When heat is required from the ſides, as well as from the fronts and top, the machine or ſtove may be fixed in the chimney fluſh with the back, leaving a ſufficient ſpace between each ſide of the machine or ſtove and each jamb of the chimney; and if heat be required from the back, as well as from the fronts, top, and ſides, the machine or ſtove may be made to ſtand out in the room, building, or place, in the manner of a Buzaglo-ſtove; or, in either caſe, it may be placed in any other convenient ſituation. The fronts, top, ſides, and back, may be made to open in the moſt convenient manner, either by means of hinges, centres, or pivots in collars, or in any other convenient mode, to clear the flues and aſh-pits; or ſmall doors may be made at convenient places in the fronts, top, ſides, and back, to open by the ſame means, for the ſame purpoſes; or, if thought more eligible, the whole may be fixed.

The

The regifter G (Fig. 1.) is intended to prevent a draught through the aperture N (Fig. 3.); the regifters HH (Fig. 1.) to prevent a draught through the appertures RR (Fig. 3.) and underneath the top plate LL (Fig. 2.); and the regifters FF (Fig. 1.) to prevent a draught through the apertures SSS, TTT, (Fig. 3.) and fo through thofe immediately connected with the fronts, fides, backs, and, if neceffary, the bottom; or regifters may be placed in, or to any other convenient part of the flues, or in the chimney itfelf. In the above, the whole of the machine or ftove is defcribed; but the improvements in it confift in conveying the fmoke, hot air, &c. through a flue or flues immediately connected with the fronts, fides, and back, or any one of them, as well as with the bottom. Among the advantages attached to this invention are, firft, the great faving in the article of fuel, for as the flame and hot air circulate through the flues of this machine, as before defcribed, confequently heating it intenfely, a very fmall fire will anfwer every purpofe of a very large one in the common way; fecondly, its cleanlinefs, which arifes from the flues being carried behind the

back

back of the chimney; and, by a regiſter and brick-work, or other proper materials, being placed from the inſide of the breaſt of the chimney to the back thereof, the whole is encloſed, and the chimney has the appearance of a receſs, ſo that no duſt or ſoot can fall upon the top plate C; and, thirdly, by its draught it will prevent the chimney from ſmoking. The next part of this invention to be deſcribed is the mode of extinguiſhing fire in the chimneys. Fig. 4. (Plate XIX.) is the ſection of a chimney: *a* is a plate of iron, copper, or lead, or any other proper material, fixed on one ſide of the chimney, to move up and down in a pivot and collar, or centres, or upon hinges, or in any other convenient manner, and of a ſufficient ſize to cover the aperture of the chimney: *b* is a rod, which may be made of iron, or of any other proper material, riſing perpendicularly a ſufficient height above the top of the chimney: *c c c c c* are pulleys, through which a wire, ſtring, chain, or other proper material, may paſs from the plate *a*, to which it is fixed at *d*, or at any other more convenient place, down the chimney to *e*, or any other more convenient place;

place; ſo that, by tightening the wire, or whatever other material may be uſed, the plate *a* may be ſuſpended between the rod *b*, and the top of the chimney *f*; or, by looſening it ſufficiently, be made to fall down upon the top of the chimney, and, ſhould the chimney be on fire by obſtructing the circulation of the air, preſently extinguiſh it; which may likewiſe be effected by cloſing-in the regiſters at the bottom of the chimney before deſcribed; or the plate, inſtead of being made to fall down upon, may lift up, or ſlide over the top of the chimney, or any other eligible mode may be uſed; and, inſtead of pulleys, cranks may be uſed, and, inſtead of being placed as in the drawing, they may be placed in any other convenient parts, and more or leſs may be uſed as required: or, inſtead of being ſuſpended by the wire, or other material, paſſing through the pulley faſtened to the rod *b*, there may be a lever fixed to the plate *a*, at *g*, which the dotted line *g h* repreſents, to which the wire, ſtring, or other material, may be fixed at *h*, and, after paſſing a hole in the chimney, paſs through the pulley *i* down the chimney. In witneſs whereof, &c.

XLV.

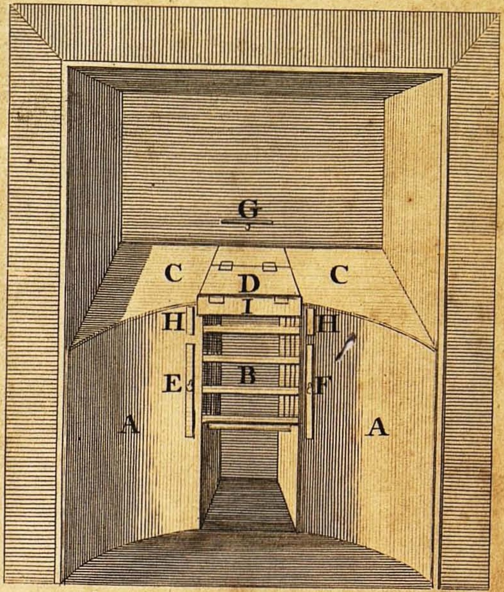


Fig.1.

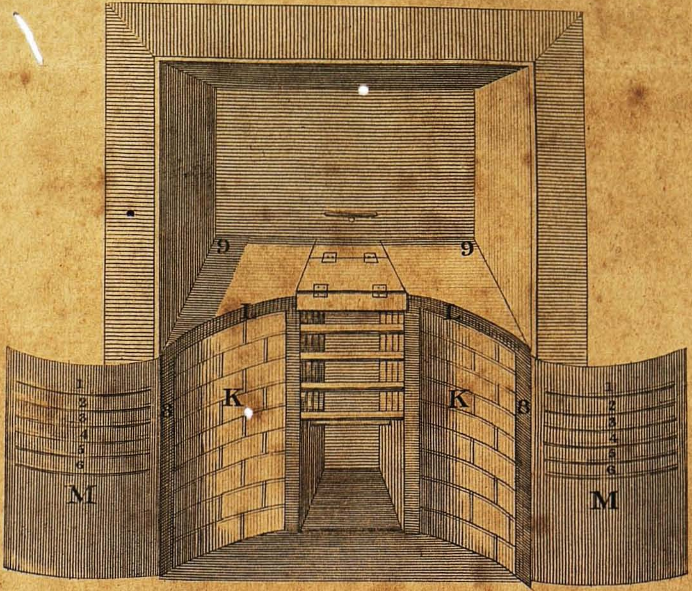


Fig.2.

Fig. 3.

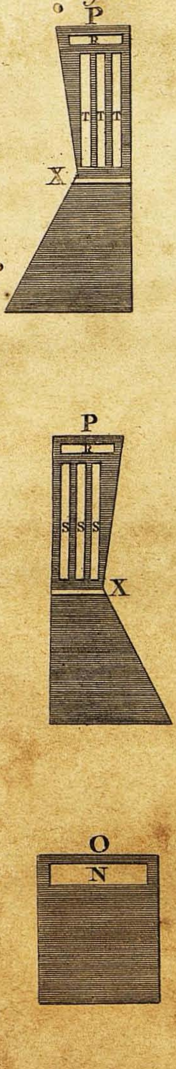
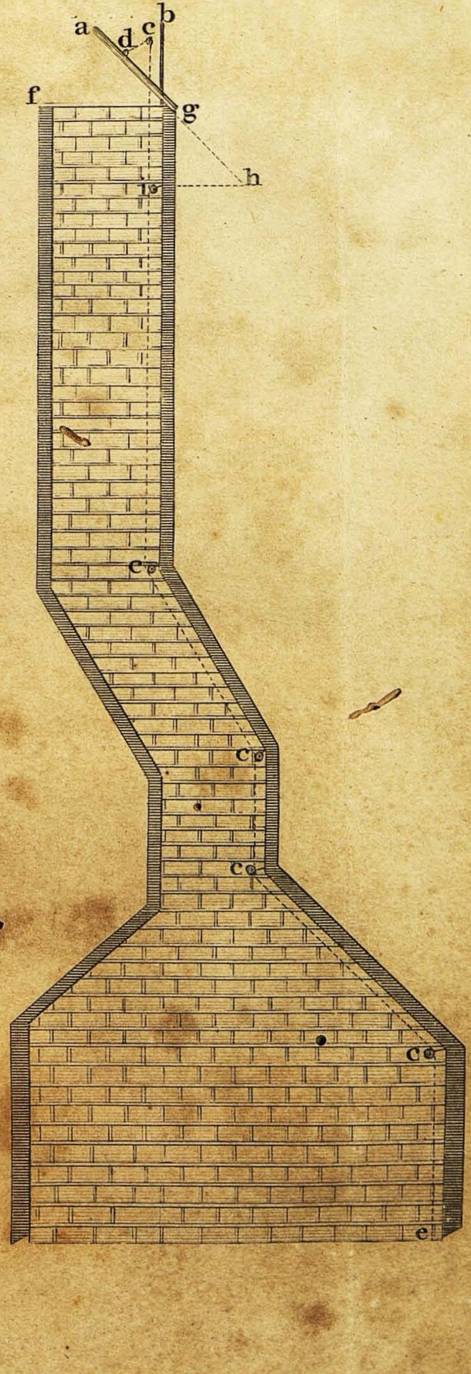


Fig. 4.



XLV. Specification of the Patent granted to WILLIAM FULLARTON, in the County of Ayr, in North Britain, Esquire; for his new Methods of separating Iron from Ironstones, &c. of smelting it into the State of Pig or Cast Iron, and reducing it into malleable Iron.

Dated June 19, 1792.

TO all to whom these presents shall come, &c. NOW KNOW YE, that I the said William Fullarton, in compliance with the said proviso, and within the time thereby limited, do hereby describe and ascertain the nature of my said invention, and in what manner the same is to be performed, as follows; that is to say, in the first place, by means of hammers, jumpers, stampers, grinders, rollers, cylinders, circles of iron, of stone, or of other materials, turning on their edges, (whether these different instruments be moved by hands, horses, steam-

engines, water-engines, or windmills, or by the application of any other adequate mechanical power,) to reduce into a pulverized ſtate the iron, ſtones, ores, and other materials in which iron is contained; previouſly calcining the material, when neceſſary, in the uſual mode, and paſſing the ſame through ſieves or bolters, whenever it may be found requiſite. In the next place, to ſeparate all earthy, impure, and extraneous matters from the metallic particles, by all or any of the following operations; namely, by waſhing, levigating, triturating, winnowing, and by the application of magnetic attraction, according to the different nature and quality of the different ſtones and ores. The materials, thus purified, are to be put into the furnace, (whether blaſt furnace, reverberatory, or any other form of furnace,) free from the groſs matter which, according to the practice hitherto in uſe, has rendered the fuſing and fluxing of iron imperfect and expenſive. And whereas the furnaces in which iron has hitherto uſually been manufactured, under the different deſcriptions of pig-iron, caſt-iron, half blooms, blooms, and bar-iron, are liable to great objections;

tions; NOW KNOW YE that, in the furnace of my conſtruction, as follows, all the different proceſſes of extracting iron from the ſtones and ores in which it is contained, and of rendering it fit to be beat out into bar-iron, are more ſpeedily, perfectly, and with leſs expence, effected; that is to ſay, this furnace is open at top, and may be made in a circular, ſquare, or oblong form, or in any other ſhape, the intention of it being to act as a crucible, from which the iron is not drawn off in the ſtate of pig-iron, as is uſual in other furnaces, but remains as a loop or regulus at the bottom; and immediately on finiſhing and taking out one melting, the furnace may be charged again, and the ſaid loop or regulus be heated and prepared for beating, or rolling, into bars. The charge, conſiſting of coke, or charcoal, and powdered iron-ſtone, or iron-ore, is brought under the influence of a bellows-pipe, which blows towards the bottom of the furnace, and the ſlag or ſcoria is removed at intervals, by a proper aperture at one end of the furnace. In witneſs whereof, &c.

XLVI. Specification of the Patent granted to Mr. JOHN HOYLE, of the Pariſh of Halifax, in the County of York, Dyer; for his Method of communicating Heat to Green-Houſes, Churches, Dwelling-Houſes, and all other Buildings.

Dated July 7, 1791.

TO all to whom theſe preſents ſhall come, &c. NOW KNOW YE that, in compliance with the ſaid proviſo, I the ſaid John Hoyle do hereby declare, that my ſaid invention is deſcribed in manner following; that is to ſay, in any place (properly ſecured from accidents by fire) contiguous to the room, or building, required to be warmed or heated, place a boiler or ſteam-kettle, of the common conſtruction, except that the bottom thereof is to conſiſt of a ſpiral flue, or funnel, at the mouth of the external circle of which is to be a ſmall grate, or receptacle for the fuel; the heat and flame being thus confined, and performing

forming the ſeveral evolutions through the funnel, will generate the ſteam much ſooner, and at a much leſs expenditure of fuel, than by any other method; the ſmoke is conveyed away by a perpendicular continuation of the funnel, from about the centre or middle of the boiler, into a chimney, or otherwiſe, as ſituation may require. From any part of the boiler, above the ſurface of the water, one or more pipes or tubes, to be charged with ſteam from the boiler, are to aſcend, or be otherwiſe conducted, into, round, or through, the room or building to be warmed or heated, and are to be either attached to the cieling or cornice, or placed lower, as may be beſt approved of; obſerving, that from the higheſt elevation they muſt form a gentle declivity, ſo as more readily to depoſit the condenſed ſteam, or water, into a ciſtern or reſervoir, into which they are to be for that purpoſe contained, and which reſervoir is to be placed as near to the boiler as circumſtances will admit. It is obvious that the heat diſpenſed will be in proportion to the length, or quantity, of the pipes or tubes introduced into the place intended to be warmed. The boiler is to have a

com-

communication with the reſervoir, by means of a pipe, intended to ſupply the water neceſſary, and that this may be properly and regularly effected, in proportion to its evaporation and eſcape, a cock and floating ball is fixed, in the ſame manner as in ciſterns or reſervoirs, withinſide the boiler, which will, at all times, preſerve the water in the boiler nearly on the ſame level, and which contrivance is equally applicable to all boilers for generating ſteam, for any purpoſe whatſoever. In order that the heat thus communicated may be checked, or regulated, and the room or building kept in a due and uniform ſtate of temperature, cocks or valves are diſpoſed in ſuch parts of the pipes or tubes as are moſt convenient, by which the ſupply of heat may be either decreaſed, or entirely ſet off or ſtopped; in which latter caſe the ſteam may be directed to ſeveral other advantageous uſes, (ſuch as blowing of all kinds of fires, or giving force to ſuch works as require power to put them in motion,) by means of one or more other pipes or tubes, branching from the boiler in any neceſſary direction; which pipes or tubes are not to be conſtructed of the ſame diameter throughout,

throughout, but muſt be formed large and capacious at the end which is attached to the boiler, and muſt run tapering, (in proportion to their required length,) ſo as to confine the ſteam in ſo narrow a compaſs that it may have conſiderable force in its iſſue. In witneſs whereof, &c.

XLVII. Specification of the Patent granted to Mr. William Menish, of Whitechapel, Chemiſt; for his improved Method of making Salammoniac, Glauber's and other Salts, for all commercial Purpoſes.

Dated July 5, 1792.

To all to whom theſe preſents ſhall come, &c. Now know ye that, in compliance with the ſaid proviſo, I the ſaid William Meniſh do hereby declare, that my ſaid invention is deſcribed in manner following; that is to ſay, mix together any quantity of vitriol of lime, gypſum, ſelenite, plaſter ſtone, plaſter of Paris, alabaſter, or any other ſubſtance, by whatever name called or known, that is compoſed

posed of calcareous earth united to volatile acid, either calcined or not calcined, reduced to powder, with such a quantity of volatile alkali, (either in the state of salt dissolved in water, or in the state of solution in which it is commonly drawn, and called volatile alkaline spirit,) as shall be sufficient to decompose the gypsum or selenite, and saturate the vitriolic acid. The quantity of each the operator will readily ascertain by experience, as no specific proportion can be laid down, the volatile alkaline solution, or spirit, varying exceedingly in the quantity of volatile alkaline salt it holds in solution, which depends upon the method employed to extract it, and the state of the different substances it is extracted from; and also whether the gypsum, selenite, &c. be free from extraneous substances, and whether it be first calcined or not. After being mixed, and repeatedly stirred together, suffer them to remain some hours to complete the decomposition; when the volatile alkaline solution, or spirit, will separate the vitriolic acid from the calcareous earth, and unite with it, and the calcareous earth will be precipitated to the bottom; from which the new combination of

of volatile alkaline ſpirit united to the vitriolic acid, or vitriolic ammoniac, may be drawn off, and is become fit and proper to be employed in manufacturing ſal-ammoniac and Glauber's ſalt. The former ſalt being compoſed of marine acid, or acid of ſea-ſalt, united to volatile alkali, the latter conſiſting of viotriolic acid and mineral alkali, the proceſs of which, being commonly known and practiſed, it is unneceſſary to deſcribe. This invention is to be underſtood to refer ſolely to the formation of vitriolic ammoniacal ſalts, or a ſolution of them, by means of vitriolic acid united to calcareous earth, by whatever name it may be called; and for employing the ſame in manufacturing of ſal-ammoniac and Glauber's ſalt, for commercial or other purpoſes; and not to exclude others from making vitriolic ammoniacal ſalts, if made from other ſubſtances which have been hitherto uſed, but to prevent their employing calcareous earths united to vitriolic acid. In witneſs whereof, &c.

XLVIII. Obſervations on keeping Milch Cows in the Houſe.

From the general View of the Agriculture of the Weſt Riding of Yorkſhire; drawn up, for the Conſideration of the Board of Agriculture, by Meſſrs. RENNIE, BROUN, and SHIRREFF.

A VERY ingenious paper upon the management of cows, in the neighbourhood of London, has been laid before the Board of Agriculture by Baron D'Alten, a foreign nobleman *; and, from the accurate calculations therein given, it appears, that keeping cows in the houſe is more profitable huſbandry than paſturing them in the field, as is commonly done.

During our ſurvey of the Weſt Riding we made repeated enquiries, whether any ſuch practice prevailed in that diſtrict; the reſult of which was, that it was only done by a few cow-keepers in

* See our laſt Number, p. 241.

towns,

towns, who had little or no land. By a letter, received ſince our return, from Mr. Stockdale, at Knareſborough, we were informed that this practice was common at Leeds; we therefore wrote to a gentleman there, deſiring him to enquire if it was found beneficial. The following is a copy of his anſwer.

Leeds, Jan. 15, 1794.

SIR,

THERE are a few cows kept in the houſe all the ſummer, and the way in which they are managed is, by giving them graſs freſh-cut, and watering the ground, as the graſs comes off, with the urine from the cows. The urine is preſerved in a ciſtern, placed on the outſide of the cow-houſe, and is conveyed to the land at almoſt all ſeaſons, but the moſt profitable time for doing it is in March, April, and May; by which means, and the addition of horſe-dung, applied during the winter months, the field may be cut four or five times during the ſeaſon. I am told that four acres of land will, in this way, maintain ten cows; and in the winter they are fed with grains from the brewers, which are very high in price, being three ſhillings and ſixpence *per* quarter. It will take

 about

about four pounds worth of grains to maintain a cow for the winter months, and two pounds for graſs during the ſummer; ſo that the expence of a cow, for the whole year, is about ſix pounds.

I kept thirteen cows one winter, which were fed upon turnips and oat-ſtraw, and never had a mouthful of hay. They yielded me thirty gallons of milk *per* day, which, ſix years ago, ſold upon the ſpot, to the retailers from Leeds, at five-pence halfpenny *per* gallon. They carried it a mile, and ſold it out at ſix-pence halfpenny, and ſeven-pence, *per* gallon; but it is now advanced to eight-pence, and nine-pence.

I muſt obſerve to you, that the taſte of the turnip is eaſily taken off the milk and butter, by diſſolving a little nitre in ſpring-water, which, being kept in a bottle, and a ſmall tea-cup full put into eight gallons of milk, when warm from the cow, entirely removes any taſte or flavour of the turnip.

In the management of cows, a warm ſtable is highly neceſſary; and currying them, like horſes,

not

not only affords them pleaſure, but makes them give their milk more freely. They ought always to be kept clean, laid dry, and have plenty of good ſweet water to drink. I have had cows giving me two gallons of milk at a time, when within ten days of calving; and I did not, upon trial, find any advantage by allowing them to go dry two months before calving. The average of our cows is about ſix gallons *per* day after quitting the calf.

I am, &c.

In addition to the above very ſenſible letter, we may add, that one of us, for ſome years, has kept his cows in the houſe, upon red clover and rye-graſs, during the ſummer months. They are put out to a ſmall park in the evening after milking, for the convenience of getting water, and tied up in the houſe early in the morning. One acre of clover has been found to go as far, in this way, as two when paſtured. More milk is produced, and the quantity of rich dung, made in this method, is ſuppoſed to compenſate the additional trouble of cutting and bringing in the graſs.

XLIX.

XLIX. Account of a method of preventing Stone Retorts from breaking; and of ſtopping them when cracked during any chemical Operation, without loſing any of the contained Subject; by Mr. THOMAS WILLIS, Chemiſt, at the Hermitage, Wapping.

From the TRANSACTIONS of the SOCIETY for the Encouragement of ARTS, MANUFACTURES, and COMMERCE.

I HAVE always found it neceſſary to uſe a previous coating, for filling up the interſtices of the earth or ſtone, which is made by diſſolving two ounces of borax in a pint of boiling water, and adding to the ſolution as much ſlaked lime as will make it into a thin paſte; this, with a common painter's bruſh, may be ſpread over ſeveral retorts, which, when dry, are then ready for the proper preſerving coating. The intention of this firſt coating

coating is, that the ſubſtances thus ſpread over, readily vitrifying in the fire, prevent any of the diſtilling matters from pervading the retort, but do in no wiſe prevent it from cracking.

Whenever I want to uſe any of the above coated retorts, after I have charged them with the ſubſtance to be diſtilled, I prepare a thin paſte, made with common linſeed-oil and flaked lime, well mixed, and perfectly plaſtic, that it may be eaſily ſpread. With this let the retorts be covered all over, except that part of the neck which is to be inſerted into the receiver; this is readily done with a painter's bruſh; the coating will be ſufficiently dry in a day or two, and they will then be fit for uſe.

With this coating I have for ſeveral years worked my ſtone retorts, without any danger of their breaking, and have frequently uſed the ſame retort four or five times; obſerving, particularly, to coat it over with the laſt-mentioned compoſition every time it is charged with freſh materials. Before I made uſe of this expedient, it was an even chance,

chance, in conducting operations in ſtone and earthen retorts, whether they did not crack every time, by which great loſs has been ſuſtained.

If, at any time during the operation, the retorts ſhould crack, ſpread ſome of the oil-compoſition thick on the part, and ſprinkle ſome powder of ſlaked lime on it, and it immediately ſtops the fiſſure, and prevents any of the diſtilling matter from pervading; even that ſubtile penetrating ſubſtance, phoſphorus, will not penetrate through it. It may be applied without danger, even when the retort is red-hot; and, when it is made a little ſtiffer, is more proper for luting veſſels than any thing I ever have tried; becauſe, if properly mixed, it will never crack, nor will it indurate ſo as to endanger the breaking the necks of the veſſels when taken off.

L.

L. Defcription of three fimple Inftruments, for drawing Architecture and Machinery in Perfpective; by James Peacock, Efq. of Finfbury-fquare, Architect.

WITH TWO PLATES.

From the Transactions of the Royal Society of London.

SOME of the following machines muft be placed upon the front edge of the table upon which they are to ftand. The fights may be fupported by a three-legged ftaff. The ftocks of the fquares or indexes may have fteel fprings upon their edges, in order to keep them in any affigned part of the grooves in which they are to flide.

Fig. 1. (Plate XX) ABCD is a drawing board, to be fixed on a table or ftand, &c. in a vertical pofition. AB, a fliding-piece for the top of the T fquare, having a rebate therein to form a groove, as expreffed by the dotted line. CD, fliding-piece for the bottom of the fquare, having a rebate to

form a groove for the reception of the ſtock, as deſcribed by the dotted line. This ſliding-piece to be of ſufficient length to receive and ſupport the ſaid ſtock, when the blade of the ſquare is coincident with the lines KMFH, or LNGI. E, a hole to receive the arm or ſlider of the ſight-piece, to be conſtructed in the uſual manner. FGHI, an opening, forming the field of view for the prototype. KLMN, a ſheet of paper, fixed on the upper part of the board for the copy; the four inner lines whereof form, and incloſe, a ſpace of the ſame dimenſions as the field of view reſpectively. OP, a ſteel ſliding-piece, equal in length to the diſtance KF, or IN. At the lower end P is a ſteel arm, terminating in a point; and at the upper end, at O, is a ſimilar arm, terminating with a braſs button, in the centre of which is a ſharp ſteel pricker; the ſaid pricker, and the point P, are to be equidiſtant from the edge of the blade of the ſquare. The arm O is to have the faculty of a ſpring, in order that the pricker may clear itſelf of the paper, as ſoon as the finger quits the button, in the ſame manner as is uſual in the apparatus of large protractors. The ſteel ſliding-piece may be drawn out of the dove-tailed or rebated

groove

groove at pleaſure, and the T ſquare will then be fit for ordinary uſes.

To uſe the Inſtrument. Having fixed the board truly level and perpendicular, and placed the point of ſight, or hole for viſion, at ſuch a height and diſtance as ſhall be productive of the beſt effect, move the ſquare with one hand, and the ſteel ſlider with the other, until the point P coincides with the eye and any point or angle in the original object. Preſs the pricker at O, and the puncture will be the true place, or copy, of ſuch original point or angle, &c.

N.B. All perpendicular lines may be drawn at once, (in pencil,) by bringing the left-hand edge of the ſquare to coincide with the original line and the eye; and their lengths may be very nearly determined by the graduated edge of the ſquare, ſo as to prevent confuſion from unneceſſary lengths of lines. The ſaid graduated edge will alſo give the points in all carved or irregular objects.

Fig. 2. (Plate XXI.) As the inſtrument, Fig. 1, proceeds by finding the poſitions of points, this is

contrived to find the positions of lines, and to determine their limits by their reciprocal intersections.

ABOCDE is a compound board, to be placed in a vertical position. FGHI is the opening, or field of view. KLMN is a loose board, upon which paper is to be fixed; and the edges of the said board are to be rebated, as described in the plan ZZ. XYMN, and OPQR are grooved recesses, to receive the said loose board as occasion may require. STUW is a movable parallelogram, composed of a rebated stock SU, two like gradulated rules ST and UW, and the regulating piece TW; the whole connected with screws, so as to move freely with a small force, and the distances between the centres of motion SU or TW to be equal to KF or HQ. AE and ED are rebated grooves, in which the stock of the parallelogram is to move.

To use the Instrument. Having fixed the compound board ABOCDE truly vertical, slip the papered board KLMN into the recess XYMN, or OPQR, as the subject to be drawn may render first necessary, and slide the stock SU, of the parallelogram, into the groove

groove A E, or E D, to correſpond therewith; then, by moving the ſtock in the groove with one hand, and at the ſame time regulating the parallelogram with the other, the top edge of the ruler U W may be brought to coincide with any line in the original object, and the figured diviſions, on the edge of the ruler, will at the ſame time determine the limits thereof, not enough to avoid a confuſion of unneceſſary length of line, &c. The true repreſentation of the place and poſition of the line may be then drawn upon the paper, by the top edge of the ruler S T, a trifle longer at each extremity than it appears to be. This operation may be repeated for as many lines as can be obtained, in the firſt poſition of the papered board and parallelogram; when they muſt be ſhifted into the other receſs and groove, to find the reſt, which may be now done without taking any farther notice of the diviſions on the rulers.

N. B. A common T ſquare, applied to a board of this kind, will anſwer moſt purpoſes. For example: place the ſtock of ſuch a ſquare in one of the grooves, having a blade not leſs than the length H K, or H R; mark the ſpaces H I and

Q R

QR upon the upper edge thereof, and divide each of them into any convenient number of equal parts, and figure the ſaid parts in the uſual manner, to correſpond with each other, as may be ſeen in Fig. I. Now, ſuppoſe the ſtock of the ſquare to be in ED, it is plain that all perpendicular lines may be drawn upon the paper KLMN in their proper places, and (by means of the diviſions on the edge of the ſquare) nearly of (though properly a trifle more than) their true length. All the lines of this deſcription being obtained, the ſhifted board muſt be placed in its other receſs, and the ſtock of the ſquare in the other groove; then, beginning with the firſt line, bring the edge of the ſquare to agree with its limits, and mark them off upon the line of the paper, and ſo of all the reſt in ſucceſſion; and join the points, where neceſſary, with a common ruler.

Fig. 3. (Plate XXI.) This apparatus is contrived to avoid the trouble of continually working againſt a board in a vertical poſition. In order to this, two ſquare boards are to be provided, equal in ſize, and of ſimilar conſtruction; one is to be fixed in a vertical poſition, for viewing the original object

object through a proper aperture, and the other is to be laid flat upon a desk, or table, for the greater ease and conveniency of drawing the copy upon paper to be fixed thereon for that purpose.

ABCD is the vertical board; EFGH the opening therein, forming the field of view; IKL the T square, the blade thereof PL being movable upon the centre P, with a moderate degree of stiffness; the stock K is to slide in a rebated or dovetailed groove AD, and to be fixable to any part thereof, by the screw O; the steel points MN are to move, with moderate ease, in a rebated or dovetailed brass groove, in the middle of the blade of the square; upon the back of the groove AD are to be fixed two brass pins QQ, to rest in proper holes, similar to the holes marked RR; and the same kind of holes are to be made in the corner of the board whereon the copy is to be made.

To use the Machine. Having placed the board ABCD in a truly vertical position, fix the shifting groove AD in the rebate, on the most convenient side of the board, by entering the pins Q into the holes R; then loosen the screw O, and move

move the ſtock IK, and at the ſame time turn the blade PL upon its centre P, until one of its edges ſhall be coincident with ſome original line; then fix the ſtock by turning the ſcrew O; move the points M and N, till they exactly include the apparent length of the ſaid line; then take off the ſhifting groove AD, together with the T ſquare, or bevil fixed thereto, and apply the ſame to the correſponding ſide of the board on your deſk or table, and draw the line of its preciſe length and poſition.

N.B. If this is thought too operoſe, the braſs groove and ſliding-pieces MN may be rejected, and the blade of the ſquare may be graduated on one or both of its edges at pleaſure; and all lines in the ſame direction may be drawn thereby exactly, as to their poſitions, and nearly, though ſomewhat exceeding their lengths *; and their preciſe lengths may be determined at the ſame time the lines in the contrary poſitions are drawn, whoſe lengths will be given at the ſame time by the lines firſt drawn.

* This will be effected by noticing the numbers upon the blade, and taking thoſe next beyond the apparent limits of the line; and by this means the drawing will advance without the leaſt confuſion.

LI.

Fig. 1.

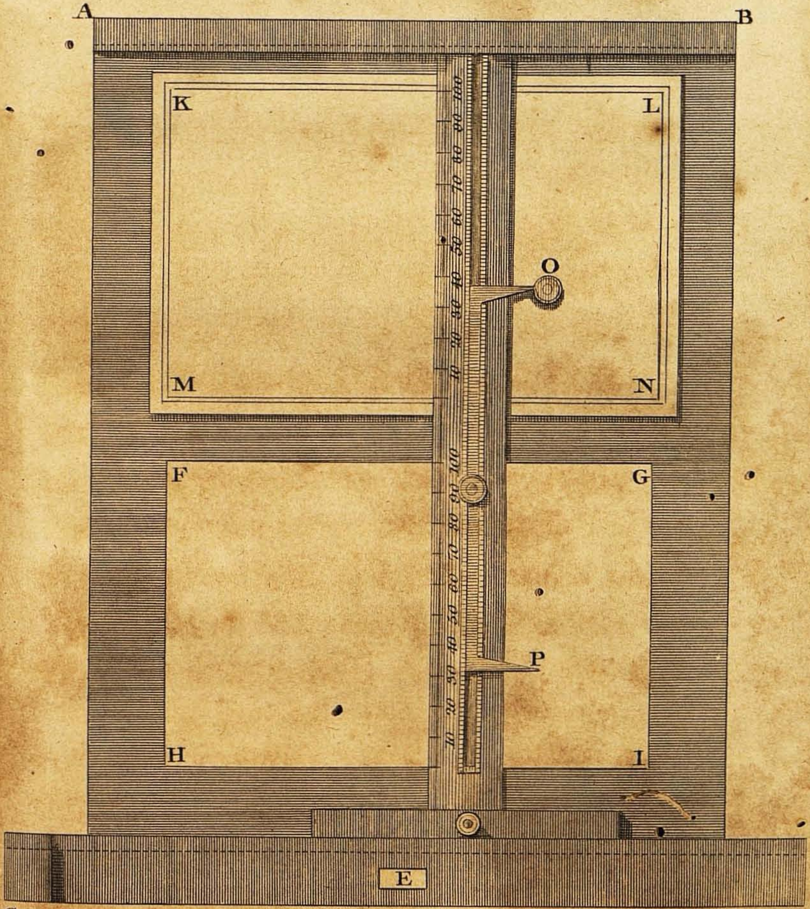


Fig. 2.

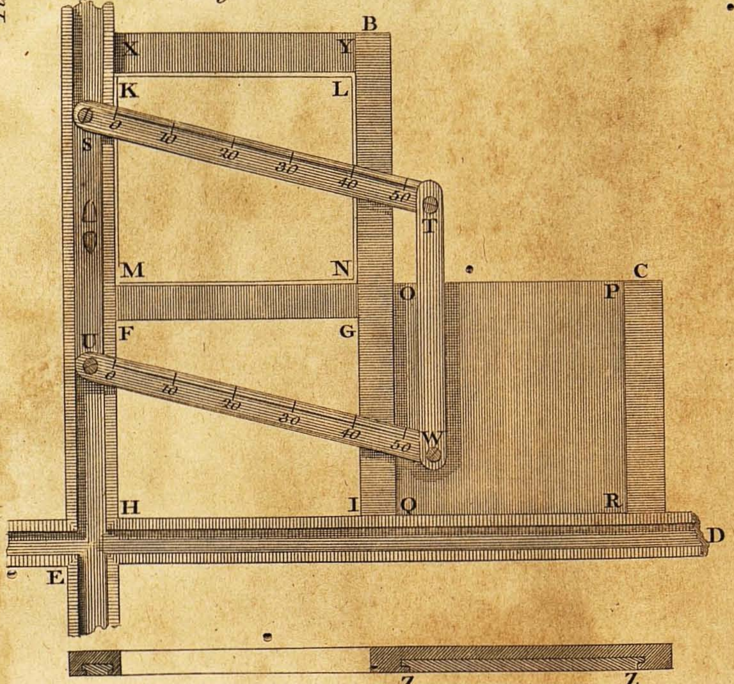
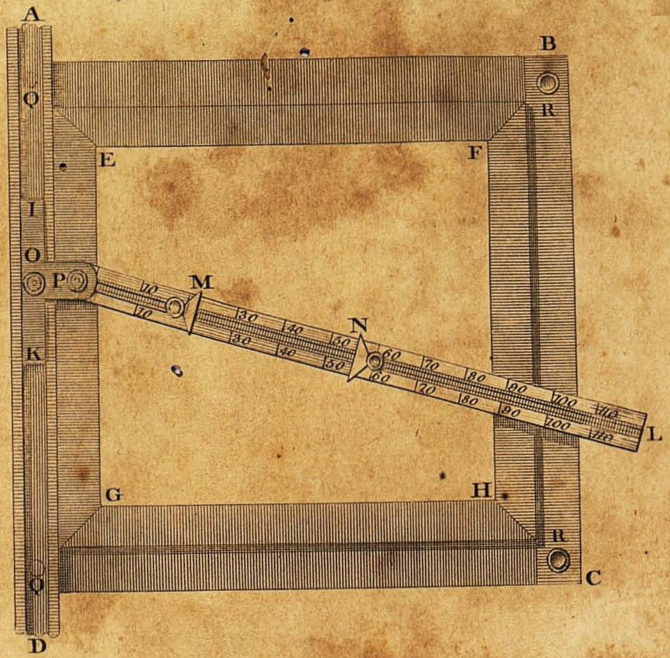


Fig. 3.



LI. Continuation of Mr. Massey's Treatiſe on Saltpetre.

(from p. 259.)

But the ſtrongeſt proofs of the exiſtence of an acid in putrid juices, if the earths of ſtables and cow-ſtalls do not afford an equal one, muſt be drawn from the ſoil at the bottoms of graves, which can certainly derive its nitrous quality from nothing but the corrupt bodies, with which it lies in contact; and this may ſatisfy us, in reſpect to the ſource from which other abſorbent earths may derive it.

Other earths, in common uſe among the ſaltpetre-makers, are thoſe of ſtables and cow-ſtalls that have drunk up much animal urine; the bottoms of ſtinking pits and ditches, and the like. Theſe they take out, and lay in heaps, till, by repeated trials, they find them fit for their purpoſe.

It is commonly ſuppoſed, that during this period they draw their nitrous quality from the air; but for this there is certainly no juſt foundation, ſeeing they are brought to maturity as ſoon, in the cloſeſt vault or cellar, as in the moſt open expoſure. The truth is, that all putrid juices contain many oily and mucilaginous parts, which, till they are duly attenuated by putrefaction, will not ſuffer any cryſtals to form in the leys that are drawn from theſe earths, which are laid in theſe heaps for this event to take place. Another end is anſwered by this manœuvre; by being thus laid apart, theſe earths are prevented from receiving any freſh ſupplies of unputrid matter, which might contaminate the juices that were already far advanced in putrefaction.

The ingenious author of the chemical dictionary has told us, that the nitrous acid is no where found, but in ſuch earths as are impregnated with the juices of vegetables and animals, and where theſe juices *have ſuſtained the whole putrefactive proceſs*. But, having aſſigned no reaſon for it, he ſeems to have been little regarded. The obſervation

tion is, however, certainly a very juſt one, and, had it been duly attended to, we imagine, might have prevented moſt of thoſe diſappointments which our countrymen have met with, in their attempts to make ſaltpetre; as we have reaſon to think they have been chiefly owing to their premature uſe of theſe earths.

The common ſoil in ſome parts of India is naturally nitrous, owing plainly to the fiſh and ſlime that is left upon it by the inundations of the river Ganges, which ſoon corrupt in that hot climate, and fill the earth with putrid juices; and here putrefaction, being carried on with the greateſt rapidity, is, of courſe, ſoon completed, and the natives are, in a ſhort time, furniſhed with a nitrous earth perfectly matured. But it muſt not be forgotten, that their ſtrongeſt earths are found at the bottoms of their tanks, or ſhallow ponds of water, which, in that country, are often of great extent, and in which, the water being evaporated by the heat of the ſun, large quantities of fiſh are left to corrupt, which furniſh a mud of the ſtrongeſt nitrous quality. In this manner nitrous earths are

naturally formed in thofe parts of the world, and might doubtlefs be formed in others, though not perhaps fo expeditioufly, by throwing into fhallow ponds of water, natural or artificial, all forts of dung and carrion, with other putrid and putrifiable matters; and the water, being evaporated by the heat of our fummers, would certainly leave a mud of the fame kind and quality.

Putrid juices and putrid vapours are difperfed through the earth and air, fo that there are few earths, of an abforbent kind, that are not, in fome degree, nitrous. But it is in thofe only that have been drenched in an extraordinary degree with thefe juices, or have been long expofed to thefe vapours, that this acid is found of any confiderable ftrength. And even here we find it but very fparingly diffeminated in them, if we may judge from the large quantity of earth that muft be elixiviated, to obtain a fmall portion of faltpetre. Cramer has told us, that two ounces of faltpetre may fometimes be extracted from one pound of earth, which we have reafon to think is an arrant fable; fince, in the city of Paris, where, we may prefume,

presume, the earths are selected with the best judgement, we shall find that one bushel of earth, with half that quantity of wood-ashes, will scarcely produce one pound of this salt: and we are informed that it requires eight cart-loads, which are perhaps small ones, to make one hundred weight. There can be no doubt, that the trifling value of the materials, and the small labour that is required, alone enable the saltpetre-makers to carry on this business; and that, under the same circumstances, it may be carried on in other places.

From the nature and constitution of these earths it must be evident, that they may be easily formed by methods of art, nothing more being necessary than to lay calcareous earths in conjunction with putrid matters, or to drench them with their juices, and to wait till we find them fit for our purpose. All this is well known; but not so, we apprehend, the process by which they are brought to maturity, which is the reason that our patience is often put to too severe a trial, in waiting for this event. It is a folly to deny that it is yet a secret, that these earths derive their peculiar quality from the putrid matters

matters with which they are connected, and that they are brought to maturity entirely by putrefaction.

Glauber, who, from the obſervations he had made upon the fruits and effects of the bottoms of ſtinking ditches, ſeems to be the firſt that attempted to form artificial nitre-beds, threw into pits, covered from the rain and ſun, but expoſed as much as poſſible to the air, all ſorts of dung, with the cuttings of trees, refuſe of gardens, and other putrid and putrefiable matters, to which he added wood aſhes; and, by this means, in a courſe of time, obtained, not a mere nitrous, but a true ſaltpetre earth, that afforded him the cryſtals of this ſalt, upon ſimple elixiviation and evaporation.

It does not appear, that this celebrated chemiſt had the leaſt idea that theſe putrid matters were of any other uſe than to draw the nitre, as he called it, from the air, in which the fixt ſalt of the wood-aſhes might poſſibly aſſiſt. In this ſtate of ignorance his followers, for the moſt part, ſeem ſtill to remain; having adopted, as far as we know, no other

other doctrine, and having varied from this practice only in disposing these materials above ground, instead of below, in order to expose them the more to this element.

It must not be passed over, that Glauber sometimes filled large wooden vessels with all kinds of dung, and, when they had completed their putrefaction, percolated a strong alkaline solution through them, drawn from lime and woodashes, which afforded him a ley of the same kind and quality with that drawn from the earth of his other nitre-beds.

A late writer has told us, that there are but three ways of obtaining nitrous earth. In *walls*, that is, by raising clay walls, and exposing them to the air. In *pits*; by throwing all sorts of putrid and putrefiable substances into them. And in *hovels*; by laying these materials in heaps under them. The first he disapproves, because, as he tells us, though these walls are generally covered with straw, the nitre, or rather the nitrous earth, that is formed upon them, is fre-

quently

quently washed away by the rain. But there is certainly another objection, and that is, the tedious time which these walls must commonly stand, except they are raised in the neighbourhood of dung-hills, before they receive any considerable impregnation. In Prussia, where we are told these walls are raised, by order of the King, throughout the country, for the use of the saltpetre-makers, we are at the same time informed, that they are often found but weakly impregnated at the end of twenty years, though dung or litter is sometimes mixt up with the clay of which they are composed.

He does not approve of disposing the materials in pits, because, as he observes, the air cannot be conveniently admitted to their interior parts; he, therefore, gives the preference to the disposal of them under hovels, where, by various contrivances that he lays down, the air may be freely admitted to them. And here we should certainly join him, could we be brought to believe that a current of air, for which he contends, was any great promoter of putrefaction. But we have been told, and have good cause to believe, that a close,

warm,

warm, moiſt air is the greateſt promoter of this proceſs; and, therefore, muſt have leave to think that a vault or cellar muſt be the moſt proper repoſitory for theſe materials, where their putrefaction, being carried on with the greateſt vigour, muſt of courſe, be the ſooner completed. Or, in defect of theſe conveniences, that the ſame end might be anſwered by laying them, about a yard thick, upon a piece of ground ſunk a few inches below the level, and bedded with clay, where, through the rain that falls in the ſpace of a year or two, they muſt be completely putrefied, particularly if they were now and then turned over, and no freſh additions were made to them; for, whilſt we continue to heap freſh materials upon old dunghills, it is impoſſible that the whole maſs ſhould be equally putrefied.

It is obſervable, that the writer laſt-mentioned ſays not a word of the uſe of putrefaction, nor of the expediency of promoting this proceſs, by all the means that lie in our power, in order to accelerate the maturity of theſe earths; which we commonly attribute to his ignorance of this circum-

ſtance; nor does the practice of the ſaltpetre-makers indicate any ſuperior knowledge. Many of the nitre-beds are raiſed ten or twelve feet high, whoſe putrefaction muſt advance very ſlowly, through the preſſure of the upper parts upon the lower, and the want of moiſture, which cannot eaſily be introduced to ſuch lofty heaps.

About thirty years ago, an ingenious chemiſt of our own nation, having viſited many of the great works abroad, and made the obſervation that, to form a nitrous earth, nothing more appeared to be neceſſary than to mix up calcareous earths with any kind of dung, and expoſe theſe materials to the air, returned home, fully perſuaded that he was maſter of the ſecret, and had intereſt enough to prevail upon many of his friends to join him, in erecting a large ſaltpetre-work at Fulham, near London. Here many hundred loads of lime were got together, and laid, with ſtrata of horſe-muck, in long high ridges, the more to be expoſed to this element; the conſequence of which was, that the rain running off without penetrating the maſs, no putrefaction enſued, and the lime, at the end of

of four or five years, was found to have received little or no impregnation; upon which the work was dropped, with great loſs to the proprietors.

Two errors were here committed. In the firſt place the dung, which ought to have been at leaſt in treble proportion to the lime, made but about one fourth of the heaps. And, ſecondly, they were ſo diſpoſed that, for want of moiſture, they could never enter into a putrid ſtate; whereas, had the dung been in a due proportion, and the whole being ſpread about a yard thick, there can be no diſpute, that, in the ſpace of a year or two, they had been perfectly putrefied, and a nitrous earth had been formed that might have prevented this cataſtrophe; eſpecially if the heap had been treated as we have before hinted.

When the author ſaw theſe materials, ſome time after the work was dropped, the dung appeared to have been quite burnt up by the lime, and to have had no effect upon it; but his judgement was not then ripe enough to point out the cauſe of this diſaſter. This work, as we have been in-

 formed,

formed, was afterwards taken up by a foreigner, who formed his nitre-beds in a very different manner; but they were raiſed ſo high, and conſequently were ſo long in arriving at maturity, as quite tired out the patience of thoſe who were concerned with him.

There may have been other reaſons for laying aſide this work, and, amongſt the reſt, its not anſwering the expectations of the proprietors in reſpect to profit; which, in new undertakings, are apt to run pretty high, without conſidering that the profits of every buſineſs depend upon the ſkill and knowledge with which it is conducted. We have before remarked, that Glauber generally added wood aſhes to the materials of which he compoſed his nitre-beds; by which means, in a courſe of time, he obtained, not a mere nitrous but a true ſaltpetre earth, which required nothing but elixiviation with water, and a ſubſequent evaporation, to afford him the cryſtals of this ſalt; which practice is ſtill followed by many of his ſucceſſors, though, as it ſeems, without any clear

clear conviction of their uſe, it being a point in diſpute, whether they are of any uſe or not.

The author of the article *nitre*, in the French Encyclopedia, boldly affirms, that the juices or decoctions of all ſuch plants as yield much fixt ſalt by incineration, being putrefied and clarified with lime, according to Mr. Bolduc's method, laid down in the Memoirs of the Academy of Sciences for the year 1734, will yield us the cryſtals of a true ſaltpetre, without the aſſiſtance of any fixt alkaline ſalt whatever; and that at Montpellier, and all over Languedoc, they make ſaltpetre, without uſing the leaſt particle of ſuch ſalt. Upon which we can only obſerve, that, if this be a fact, it muſt be very ſurpriſing that it is not known at Paris, and that the gentlemen of the academy, who, ſome time ago, drew up and publiſhed, by order of their monarch, an account of the ſeveral methods of making ſaltpetre in all parts of the world, ſo far as they could arrive at the knowledge of them, ſhould not take the leaſt notice of it; though they have thought proper to record

record one of a ſimilar nature, Mr. Brown's method of making ſaltpetre in Virginia.

This gentleman tells us, that if we ſprinkle the clay-floor of a tobacco-houſe with *ambeer*, which we take to be a putrid infuſion of tobacco, and cover it with the rotten leaves, in a fortnight's time, upon removing the leaves, we ſhall find the floor covered with ſaltpetre, in the form of hoar-froſt, drawn from the air, which, being ſwept up, and elixiviated with warm water, will afford us a ley, that, being boiled down to the conſiſtence of cream, will ſhoot into cryſtals of this ſalt. Now we can eaſily believe, that theſe ſweepings, with the aſſiſtance of wood aſhes, would afford us ſuch a ley, but not without; and therefore muſt conclude, that there is here ſome omiſſion. We muſt farther obſerve, that this gentleman takes no notice of any marine ſalt that is formed in this ley, which, being found in all nitrous leys, muſt render this account very ſuſpicious; and what may give us a more unfavourable opinion of this method is, that, ſince the author obtained a reward of three hundred pounds from the Britiſh Parlia-

ment

ment for this notable diſcovery, we have heard no more of it.

Whilſt the ſeveral parts, or principles, of which this ſaline concrete is compoſed, remained unknown, we might give credit to a number of tales, reſpecting its origin and formation, which, at this time, without betraying the greateſt weakneſs, we cannot give the leaſt ear to; of its being drawn from the air; of its being generated in vegetables and animals; of its being found upon the ſurface of old walls; and, to conclude the whole, of its being formed without the aſſiſtance of a fixt ſalt; all which muſt be found equally repugnant to reaſon and experience, which we may bring the ordinary practice of making ſaltpetre to confirm. And here we cannot help expreſſing our ſurpriſe, that ſo much time has been ſpent, by many ingenious perſons, in the diſcovery of *new* methods of making ſaltpetre, when it muſt be obvious, that, in caſe they ſucceeded, there is none that could be more plain, ſimple, and leſs expenſive, than the *old* and approved one, of which we ſhall now proceed to give a more particular account.

In

In large and populous towns the ſaltpetre-makers chiefly make uſe of the rubbiſh of old houſes, the ruins of old vaults and cellars, &c. Theſe they collect, and, having reduced them to a coarſe powder, elixiviate them with about one third the quantity of wood-aſhes; in which ley, when boiled down to a due conſiſtence, the cryſtals of ſaltpetre are found to ſhoot. During the boiling, large quantities of marine ſalt are formed in this lixivium, which, cryſtallizing whilſt the liquor is hot, are taken out with perforated ladles. The ley is then taken out, and ſet in a cool place, for the ſaltpetre to cryſtallize. In defect of theſe earths, they collect thoſe of ſtables and cow-ſtalls that have drunk up much animal urine, the bottoms of ſtinking pits and ditches, eſpecially of thoſe that have received the contents of ſlaughter and privy houſes, theſe they take out and lay in heaps, commonly mixt up with a little lime, till, by repeated trials, they find them fit for their purpoſe; which is known, in ſome meaſure, by their having totally loſt their offenſive odour, a ſure ſign that their putrefaction is completed.

Where

Where theſe earths cannot be procured in ſufficient quantities, they form what are called artificial nitre-beds, by laying all ſorts of putrid and putrefiable ſubſtances in conjunction with calcareous earths, keeping them in a moiſt ſtate, and waiting, as the phraſe is, till they are brought to maturity. If wood-aſhes are not added when theſe materials are committed to putrefaction, they are added when they are elixiviated, but are never, that we have heard, omitted.

The common peaſants in France and Germany, who are almoſt all ſaltpetre-makers, ſcrape together the muck and offal of their farm-yards, and throwing them under open ſheds, ſuffer them to lie till they find they will anſwer their end. Though they know little of the uſe of putrefaction, they take care to promote this proceſs, by drenching them with urine or muck-water, and frequently turning them over, by which means they are brought to maturity much ſooner than the larger nitre-beds. Theſe materials, with the wood-aſhes their hearths ſupply, (if the latter are not added before,) are thrown into a large tub, and water is

poured upon them, which runs out through a hole ſtuft with ſtraw, at the bottom of the veſſel. Thus ſimply do they procure their leys, in the boiling of which their women and children are chiefly employed.

Where any article of commerce is compoſed of materials of little or no value, and which requires ſome ſkill or ingenuity to manufacture, great numbers of poor perſons will naturally take up this employment, whoſe diſtreſſes will oblige them to diſpoſe of it upon the moſt moderate terms; to which they will be further urged by the policy of the government under which they live, which will reſtrain them from exporting it till its own wants are ſupplied. To this we may fairly attribute the ſmall price that ſaltpetre bears in France and Germany; but this can be no diſcouragement to the Engliſh, among whom it bears a much greater price, notwithſtanding the importations of their India Company; and, conſequently, would afford the makers a much greater profit, even ſhould government refuſe, by a ſmall bounty of one penny *per* pound, upon all ſaltpetre made in England, to give them ſuitable encouragement.

The

The French are not insensible of the great advantages they derive from making their own saltpetre; and, therefore, pay no small attention to it. The saltpetre-makers in Paris are incorporated, and have, besides, the privilege of carrying off the rubbish of all the old houses they shall think fit, without fee or reward; though this indeed is but a poor compensation for the extraordinary expence they are put to in firing, in a city where fuel is so dear.

In the year 1775, some defect being found in the saltpetre brought to market, owing more, perhaps, to their parsimonious methods of making it than to any thing else, the king of France ordered a committee of the gentlemen of the Academy to draw up, and publish, an account of the several methods of making saltpetre, in all parts of the world, that all his subjects might be made acquainted with them; and, at the same time, offered a considerable reward to whomever should discover the secret of nature in the formation of this salt, that they might equally avail themselves of it.

 It

It has been ſhewn, that nitrous earths are not uncommon in the walks of nature, and that, by the addition of wood-aſhes to them, they are converted into true ſaltpetre earths. Now, it is only allowing that theſe aſhes may ſometimes be accidentally introduced to an earth of this kind, to ſhew us how a true ſaltpetre earth may naturally be formed; and if the ſtreets of the city of Paris, or their dunghills, upon which they throw their wood-aſhes, ſometimes exhibit a true ſaltpetre earth, it can be no great wonder.

It can ſcarcely be conceived that the Engliſh have been ignorant of the method of making ſaltpetre in France and Germany, where this buſineſs has been long carried on in the moſt public and open manner. But that ſome points of no ſmall importance may have eſcaped their obſervation, may eaſily be credited, from the ill ſucceſs with which their attempts have always been attended; and none more likely than their cuſtom of waiting till the materials they lay together, for this purpoſe, are found fit to anſwer their end.

TO BE CONCLUDED IN OUR NEXT.

XLIII. Continuation of the Chevalier de St. REAL's Memoir on rendering Leather impermeable to Water.

(FROM p. 288.)

EXPERIMENT IX. I put into a glafs veffel fome very ftrong carpenters glue; and, after filling the veffel with water, I placed it on a fand-bath. I then made a very fmall fire under it, which I increafed fo gradually, that four hours had elapfed before the water was heated to 60 degrees; (167 of Fahrenheit;) but at the end of that time, and at that degree of heat, the glue was diffolved. The glafs veffel was then taken from the fand, and the folution, when cooled, became a ftrong jelly. I placed the veffel again on the fand-bath, and, having put a thermometer into it, found that, when the jelly was melted, the thermometer was at 48 degrees. (140 of Fahrenheit.) It follows, from this experiment, that a heat of 48 degrees is fufficient to diffolve animal jelly.

Experiment X. In order to afcertain whether a fimilar degree of heat would affect the fkins of

 animals,

animals, I put, on a ſand-bath, a glaſs veſſel full of water, into which I threw ſeveral pieces of cow and calves ſkin, which had previouſly been well waſhed. I then heated the water, and as ſoon as the thermometer, which was plunged in it, had riſen one degree above 40, (122 of Fahrenheit,) I took one of the pieces of ſkin out of the veſſel: I continued taking them out, as the thermometer roſe, one at each degree, till I had taken out twenty-eight; ſo that the laſt which I took out had undergone a heat of 68 degrees. (185 of Fahrenheit.) I examined all theſe pieces of ſkin, one after the other, and found that they were all very ſoft, and that thoſe which had ſuffered a heat of 48 degrees (140 of Fahrenheit) were in a ſtate to have the hair taken off. Thoſe which had remained till towards the end of the operation were a little rolled up at the edges, and the piece which was taken out laſt of all was diminiſhed every way, and was brittle, though that which was taken out immediately before it, and which conſequently had been expoſed to a heat of 67 degrees, (182¾ of Fahrenheit,) did not appear to have ſuffered any material alteration; all of them, however, in drying

drying became thin, rather tranſparent, and ſomewhat like parchment. I have repeated this experiment more than a hundred times, upon all ſorts of tanned leather; and none of them appeared to have been injured by it, provided they were not expoſed to a heat above 60 degrees. It may therefore be ſtated as a fact, that the fibrous part of the ſkin ſuffers no alteration from a heat of 60 degrees, in places where the mean height of the barometer is 26 inches 4 lines, that being the mean height where I made theſe experiments.

From them, and the preceding ones, it appears that ſkins may be tanned, with advantage to the quality of the leather, and with benefit to the proprietors of tanneries, by reducing all the proceſſes of the art to the following:

1. To ſoak the green hides, ſeparate from each other, in running water, a ſufficient time to extract all the lymph; it will be eaſy to determine when that is done, by putting a piece of the hide into water, and heating the water gradually; if no ſcum is formed upon the ſurface, it is a proof that no more lymph remains.

2. To

2. To place the hides (after they have been waſhed and cleaned) in a caldron, made on purpoſe for this operation, and conſtructed pretty much like thoſe in which common ſalt is made; to fill the caldron with water, which is to be heated to 60 degrees, (167 of Fahrenheit,) and no more *: after the hides have been one hour expoſed to this degree of heat to take them out.

3. To place them upon the horſe, to ſtretch them, and to proceed to take off the hair in the uſual manner.

4. To put them again into the caldron, (which ſhould be ſo contrived that it may receive, from a cock, as much water as it lets out, from a cock, on the other ſide,) and to keep up in this caldron a conſtant current of water, of the heat of 60 degrees.

5. To let the hides remain in this caldron, till the water no longer contains any animal jelly;

* If my experiments upon tanning in a large way ſucceed, I ſhall publiſh the means of giving to water the preciſe heat of ſixty degrees, and of keeping it conſtantly at that temperature, by a method which is ſimple, cheap, and applicable to large manufactories.

which

which may be eafily known by evaporating a fmall quantity of it.

6. To take the hides out of the water, and place them upon the horfe, that the cellular membrane and *panniculus carnofus* may be taken of.

7. To wafh the hides again in running water, then to put them into the caldron from which they were taken, or one fimilar to it, which is to be filled with filtered tan liquor. To give the liquor the fame degree of heat the water had, in the former operation, and to leave the fkins in it till they are completely tanned; taking care to put frefh tan liquor in the place of that which fhall appear to have loft its energy, by the combination of its aftringent principles with the hides: this may be readily known, by dropping in a few drops of a folution of green vitriol.

It is very evident that all the proceffes, directed in the feven articles abovementioned, are founded upon experiments fufficiently decifive in their nature to give hopes of their fucceeding, when ufed

 in

in the large way of a manufacturing eſtabliſhment. The leather made according to them would be more free from animal jelly than any other, and conſequently would be leſs ſuſceptible of moiſture. The fibrous part of the ſkin, being acted upon by tan liquor rendered more efficacious by being heated, would become more conſiſtent, more firm, and more difficult to be penetrated; it would be increaſed in ſtrength and compactneſs, without loſing any part of its ſuppleneſs. That excellent Swediſh leather, ſo ſuperior to all others, of which not only boots are made, but alſo breeches, and great coats capable of reſiſting the moſt violent rains, is prepared in Jæmtland with hot water.

In the preſent ſtate of my knowledge reſpecting tanning, I ſee no plauſible objection to the ſcheme I have propoſed, except the expence which would ariſe from the neceſſary conſumption of wood or pit-coal; but that expence I think would not be ſo great as might at firſt be imagined, ſince it would be neceſſary to make but a very ſmall fire; and it would be compenſated by the ſaving of a conſiderable quantity of quick-lime, (which is itſelf made

made only by means of fire,) by ſaving at leaſt half the uſual quantity of labour, and, finally, by the ineſtimable advantage of a more ſpeedy return of the capital employed. So that, upon the whole, it appears to me that the leather, though much better, would not be at ſo high a price as that which it now bears. If, however, any local circumſtances, ſuch as an abſolute want of fuel, or its being at an enormous price, ſhould render it impracticable to make uſe of the tan-liquor hot, it may be uſed cold, and the method I have propoſed might ſtill be followed in all other reſpects; then, indeed, what would be ſaved in fuel would be loſt in time, but the leather would ſtill be much ſuperior to that which is tanned in the uſual manner.

SECOND SECTION.

Obſervations on the art of the currier; and on the means of currying leather in ſuch a manner as to render it impermeable to water, without injuring its ſtrength or ſuppleneſs.

The operations deſcribed, in the former ſection, are applicable only to ſtrong ox or cow leather,

 which

which is hardly ever used for any other purpose than for making the outer soles of shoes and boots; and, though (from the universal use of this kind of leather, and, from its being exposed, by the nature of its use, to perpetual friction and blows) it is of the greatest importance that we should be assured of its goodness, yet it is never curried. The tanner contents himself, before he delivers the leather to the shoe-maker, with beating those parts which are soft, or which have a very irregular surface, upon a smooth log of wood with a mallet. The more careful tanners, indeed, beat all their hides; and this practice is general in England.

But, besides the strong sole-leather already mentioned, leather of a different kind is used in a great variety of arts and manufactures, the tanning of which is performed in much less time; perhaps because the uses to which it is destined do not require so much strength, or from an apprehension that a more perfect combination of the astringent principle of the tan, with a fibrous part, might diminish its suppleness. This kind of leather

also

alſo is made of ſkins of cows and oxen, but more generally of calves ſkins. It ſerves to make the ſoles of pumps, or of women's ſhoes, or the inner ſoles of men's ſhoes, the upper leathers, and, in ſhort, any kind of work in which the thickeſt and ſtrongeſt leather is not required. This leather is always worked with lime, even in thoſe tanneries in which other methods are adopted for the ſtrong ſole-leather. Six months, in the pits, is ſufficient for this leather, according to the uſual method of proceeding, and perhaps leſs than two might ſerve, if hot tan-liquor were made uſe of. Be that as it may, all this ſort of leather is curried, and, beſides the uſes already mentioned, it is employed for belts, for harneſſes, for covering trunks, &c. Some of it is prepared *in grain*, for the ſame purpoſes as the other, but it has a better appearance.

A minute deſcription of all the operations of the currier would be uſeleſs to the object of my enquiry; a very ſhort review of them will be ſufficient to ſhew their end, and the means by which that end is accompliſhed. Leather as it comes out

out of the pits, immediately after the operation of tanning, is by no means fit for the various uſes for which it is intended; it is rough, of an unequal thickneſs, ſtiff and unmanageable. The object of the currier's art is to ſupple it, and to give it an uniform compactneſs and denſity. This object he fulfils by the following operations.

1. He treads the ſkins: that is, after having ſoaked them till they are ſoftened, he kneads them with his feet, to make the water penetrate every part equally.

2. He works them with the pummel; this is done by applying to the ſkins, after they are trod, a ſquare tool made of hard wood, about a foot long and five inches broad, furrowed longitudinally, convex at the bottom, and flat at top, where it is fixed to the workman's hand by a leather ſtrap, ſo that it cannot ſlip. This tool, by being worked forcibly along both ſides of the ſkin, that is to ſay, both upon the ſide on which is the epidermis, and on that of the fleſh, forms the grain of the leather, and gives it ſuppleneſs.

3. He

3. He then works the ſkin with an iron inſtrument with a blunt edge; with this he ſcrapes very ſtrongly thoſe parts which are too thick, thoſe in which there is left any fleſh, or any tan, and thoſe in which there are any hollows; ſtriving, as it were, to preſs the ſuperfluities of the thick parts into thoſe which are too thin, and thus to give to every part of the ſkin an equal thickneſs, and an uniform denſity.

4. He pares the ſkin with a paring-knife; this paring-knife is circular; with it the workman takes away thoſe thick and projecting parts which the operation juſt deſcribed was not able to remove: ſo that this laſt operation may be conſidered as completing the intention propoſed by the preceding one.

After the four operations above-mentioned, the leather is ſupple and ſmooth, and of an equal thickneſs and denſity in all its parts; it is now become fit to be employed by the workmen who make uſe of it. But the very operations which give it theſe valuable qualities ſeem to injure its compactneſs.

compactneſs. The leather, by being beat, ſtretched, and ſcraped, muſt neceſſarily become more ſpongy, and conſequently more permeable to water. To remedy this inconvenience, the currier impregnates it with fat, or oil.

To dreſs leather with fat, it muſt be firſt made perfectly dry. The pores of the leather are then dilated, by paſſing it over a clear ſtraw fire; and it is rubbed over with a kind of woollen mop, dipt in melted fat, pretty hot. The fat, thus applied to each ſide of the leather, penetrates into its ſubſtance, lodging within its pores, and, adhering there, fills them up ſo as to preclude the entrance of any moiſture; ſhould the leather be wet when the fat is applied, it will remain upon the ſurface, and not penetrate into the ſubſtance.

The manner of dreſſing leather with oil is more ſcientific, and the theory of the operation is much more complex. It is founded upon the property which water poſſeſſes, of ſwelling thoſe ſupple and elaſtic capillary tubes into which it inſinuates itſelf; upon that of its not being miſcible with

with oil; and upon that of its evaporating much more ſpeedily than oil. The currier, therefore, ſoaks in water thoſe ſkins which he means to dreſs with oil; and, while they are yet wet, he ſpreads over them, with wool, any kind of fiſh-oil. As the water evaporates, the oil takes its place, and conſequently the more the ſkins were ſwelled with water, the more thoroughly they become impregnated with oil.

The art of giving leather a black colour belongs alſo to the currier; that operation, however, contributes nothing to its goodneſs, but is merely done for convenience, and it muſt be acknowledged that it is a conſiderable one: for the leather becomes thereby leſs liable to have a dirty appearance, and it is alſo much eaſier to preſerve it of a black colour than of a white or any other. The black colour is given to leather by rubbing it with a ſolution of iron in wine, or beer, or ſour whey. The workman moiſtens the ſurface of the leather, before the compoſition which is to give it a black colour is applied.

Every part of the operation of currying leather tends to fulfil the object of the queſtion propoſed by the Academy of Lyons, and in fact does fulfil it to a certain degree; it even appears that we might content ourſelves with the operation of the currier, provided the art of tanning were brought to perfection, and the ſtrong ſole-leather, inſtead of being uſed as it comes out of the hands of the tanner, were to undergo ſome kind of treatment which it is not in his province to beſtow.

Nevertheleſs, in order to determine to what degree leather, in general, (ſuch as is uſed in commerce, and fabricated in Savoy, in Switzerland, and in Auvergne,) is capable of imbibing water, I made the following experiments.

TO BE CONCLUDED IN OUR NEXT.

LIII. Obſervations of oxygenated Muriatic Acid; by M. CHAPTAL, of the Royal Society of Montpellier.

From the Memoirs of the ACADEMY of SCIENCES of PARIS.

WE are indebted to the celebrated Scheele for the diſcovery of the oxygenated muriatic acid; but we owe to M. Berthollet the knowledge of its nature, its uſe, and its principal properties. In repeating the numerous and intereſting experiments which have been lately made upon this ſubſtance, I have obſerved ſome new facts; and I think I have thrown ſome light upon others, of which only a glimpſe had been perceived; I ſhall, therefore, in as few words as poſſible, relate all that appears to me deſerving to be known.

The property, which oxygenated muriatic acid poſſeſſes, of bleaching linen, cotton, and yellow wax, (when cut into ſlices,) is a diſcovery with which M. Berthollet has already enriched the arts; but

it appeared to me that we might extend the application of it to other matters, and, in confequence of that idea, I have made fome experiments on the means of bleaching paper, of which the following are the refults.

Blotting-paper, by being put into this acid, is bleached without fuffering any injury; and rags of coarfe bad cloth, fuch as are ufed in the paper-manufactories to make this kind of paper, may be bleached by this acid, and will then furnifh paper of a very fuperior quality. I bleached by it an hundred weight of pafte, intended to be made into blotting-paper, and the increafe of value in the product was computed at twenty-five *per cent.*; whereas the expence of the operation, when calculated in the ftricteft manner, amounted only to feven *per cent.*

The property poffeffed by this acid, of bleaching paper without injuring its texture, renders it very valuable for reftoring old books, and fmoked prints. The latter, when difcoloured to fuch a degree that the fubject of them could hardly be

 diftin-

diſtinguiſhed, were re-eſtabliſhed and revived, in ſo aſtoniſhing a manner that they appeared to be new; and old books, ſoiled by that yellow tinge which time always produces, may be ſo completely renewed, that one might ſuppoſe them to be juſt come out of the preſs.

The ſimple immerſion of a print in oxygenated muriatic acid (leaving it therein a longer or a ſhorter time, according to the ſtrength of the liquor) is all that is required for bleaching it; but, when a book is to be bleached, ſome farther precautions are to be uſed. As it is neceſſary that the acid ſhould wet every one of the leaves, the book muſt be completely ſpread open, and then, by letting the boards of the binding reſt upon the ſides of the veſſel, the paper only will be immerſed in the liquor. If any of the leaves ſtick together, they muſt be carefully ſeparated, that all of them may be equally impregnated. The liquor takes a yellow tinge, the paper grows white, and after two or three hours the book may be taken out of the liquor, and ſoaked in clean water, which ſhould be changed from time to time, in

order

order to waſh out the acid with which the book is impregnated, and alſo to deprive it of the diſagreeable ſmell it has contracted.

The above method, which is the firſt I made uſe of, has generally ſucceeded pretty well; too often, however, the leaves of my books have had a motley appearance, and ſometimes ſeveral pages were not at all bleached; I was, therefore, obliged to have recourſe to the following more certain proceſs. I began by unſewing the books, and reducing them into ſheets; theſe ſheets I placed in diviſions made in a leaden veſſel, by means of thin ſlips of wood, ſo that the leaves, when laid flat, were ſeparated from each other by very ſmall intervals. I then put the acid into the veſſel, pouring it againſt the ſide, that the leaves might not be diſturbed; and, when the operation was finiſhed, I drew off the acid, by means of a cock fixed in the bottom of the veſſel. I then filled the veſſel with clean water, which waſhed the leaves, and took off the ſmell of the oxygenated acid. They may then be dried, ſmoothed, and new-bound. In this manner I have reſtored many va-

luable

luable books, which had become worthleſs from the bad ſtate they were in.

Inſtead of the method above deſcribed, the leaves may be placed vertically in the veſſel, and this poſition is attended with ſome advantage, as they are leſs eaſily torn. For this purpoſe I have conſtructed a frame of wood, which I fix to the height I think moſt convenient, according to that of the leaves I wiſh to bleach. This frame ſupports a number of very thin ſlips of wood, which leave between them only the ſpace of about the twentieth of an inch; I put two leaves in each of theſe ſpaces, and I fix them by means of two ſmall wooden wedges, which I thruſt in between the ſlips, and which preſs the leaves againſt the ſlips. I have another reaſon for preferring this method to the other, namely, that, when the operation is finiſhed, I can take out the frame with the leaves in it, and plunge the whole together into clean water. By this operation the books are not merely reſtored to their original ſtate, but the paper acquires a degree of whiteneſs it never before poſſeſſed. The acid alſo has the good effect of intirely taking

away

away ſpots of ink, by which books and prints are often much disfigured. This liquor, indeed, has no effect upon ſpots of oil, or other greaſe; but it has long been well known that a weak ſolution of cauſtic alkali furniſhes a certain means of removing them.

When I had to bleach prints ſo torn to pieces that they conſiſted only of fragments fitted together, and paſted upon paper, I was afraid I might loſe ſome of theſe fragments in the liquor, becauſe they ſeparate from the paper by the ſoftening of the paſte; in that caſe, therefore, I took the precaution of encloſing the print in a large cylindrical bottle, which I turned upſide-down, fixing its mouth to that of a veſſel in which I had put a mixture proper for diſengaging oxygenated muriatic gas; this gas fills the inſide of the bottle, and, acting upon the print, takes off the ſtains, ink-ſpots, &c. while the fragments remain paſted to the paper, and conſequently keep their reſpective places.

TO BE CONCLUDED IN OUR NEXT.

Printed by JOHN NICHOLS, Red-Lion-Paſſage, Fleet-Street, London.

REPERTORY OF ARTS AND MANUFACTURES.

NUMBER VI.

Printed by JOHN NICHOLS, Red-Lion-Paſſage, Fleet-Street, London.

LIV. Specification of the Patent granted to Mr. JOSEPH BRAMAH, of Denmark-ſtreet, St. Giles's; for a Water-Cock upon a new Conſtruction.

WITH A PLATE.

Dated December 1, 1783.

TO all to whom theſe preſents ſhall come, &c. NOW KNOW YE that, in compliance with the ſaid proviſo, I the ſaid Joſeph Bramah do hereby declare, that my ſaid invention is compoſed and made in the manner following; that is to ſay, the merits of this my ſaid invention in no wiſe depend

on any peculiar metal, of which these my said invented cocks are or may be made, but their essential properties, and superior excellence, entirely depend on the construction and application of a plug, or valve, which opens or shuts the passage, or water-way; and also more particularly on the method of opening and shutting the said plug, or valve; and on its being more convenient, and much more durable, than any other means hitherto found out or invented; and farther, on the said plug, or valve, being contrived in such a manner as to be capable of opening and shutting a much greater water-way, with much less metal, than by any other means yet made public, capable of answering the intended purposes for which cocks are used; and likewise on the various ways this said plug, or valve, may, with equal propriety and success, be applied; agreeable to the situation in which the said cocks may be used, the said plug or valve may shut either with or against the *gravitating* current of the water, or other fluid thereby meant to be retained, without altering or losing any of the essential properties above mentioned. The shape and size also of the said cock may be varied

varied indeterminately, as occafion may require, without in the leaft departing from that principle on which their fuperior efficacy and utility chiefly depend. The figures or drawings in the margin of thefe prefents, together with the demonftration or defcription therewith given, will plainly fhew the true nature and difpofition of the parts of this my faid invention. In witnefs whereof, &c.

The drawing of the cock, Fig. 1. (Plate XXII.) reprefents the different modes of conftructing or adapting it to the various purpofes to which it is, or may be, applied; and alfo the different ways of opening and fhutting the water-way thereof, by means of a plug, or valve, on a new conftruction. Firft, let it be confidered, that A A is the water-way of a ftop-cock, through which the water, or other fluid, always paffes from H to I, or from I to H. B is the plug, or valve, that fhuts or opens this water-way; it is turned conical, and its leaft diameter is equal to the diameter of the water-way A A. To this plug, or valve, B, is joined a fpindle, or flider, CC, with one of its ends exactly in the centre of the greater diameter of the cone, or plug, B,

 and

manner. The ſpindle CC, and the threads of the ſcrew-plug FF, are made water-proof, by introducing into the cavity G, between the bottom of the ſcrew-plug and the plate, or bottom, D, ſome leather, or other elaſtic or flexible material, ſuch as felt, cloth, &c. according to the purpoſe for which the cock is meant to be uſed, namely, for hot or cold liquor; for the former, felt is moſt proper, and, for the latter, leather. The manner in which this felt or leather is applied is repreſented in Fig. 3, where G is the cavity where the ſpindle C and plug EF are ſituated, and which are to be made water-proof. B is the plate or bottom, which reſts on the ledge *e*. H is a piece of leather, or felt, that is cut circular, and its diameter greater than the diameter of the box, or cavity, G; in the centre of the leather, or felt, is perforated, or cut, a hole, barely the ſize of the ſpindle C; through this hole the top part of the ſpindle paſſes; the leather, or felt, is then preſſed into a conical form, as at H, till its circumference is reduced ſo as to be within the diameter of the cylinder G, and is then forced down to the bottom, or plate, B, with its extreme edge;

there

there the ſcrew-plug E F is ſcrewed down upon it, and, by its preſſing on the higeſt part of H, cauſes it to force againſt the ſides of the box G, and againſt the ſpindle C, on all ſides, ſo as to prevent any fluid whatſoever from eſcaping from the water-way, notwithſtanding the preſſure thereof being ever ſo great; by the tightening this ſcrew-plug, or nut, the defect of the leather, &c. (occaſioned by wearing, will be made good for many years, it may alſo be renewed at any time in a few minutes. Either end of the cock, H or I, (Fig. 1.) may be applied towards the ciſtern or fountain-head; but the end, I, will, in moſt caſes, have the preference, as then the gravity of the incumbent fluid will always keep the plug, or valve, B, perfectly cloſe ſhut, when, on the other hand, H being thus applied, the fluid would then paſs on the under ſide of the plug, or valve, B, and force it up, and let the liquor eſcape; to prevent which, there may be applied, at the external end of the ſpindle, ſome force or power, ſuch as ſpring, weight, ſcrew, inclining plane, or other contrivance, ſufficient to overcome the greater preſſure of the fluid thereby meant to be retained. This

way

way of applying the plug, or valve, may in ſome works have the advantage, for inſtance, where the end H is fixed into a ciſtern, caſk, &c. in a ſituation expoſed to the froſt; the end I, or that part of the water-way A G I, will remain always without water, ſo that the plug, or valve, B, cannot have its movements ſet faſt by the freezing of that part. But a more effectual method of preventing this complaint is by applying the plug, or valve, in the manner deſcribed in the drawing, (Fig. 2.) when it is uſed for ciſterns, vats, caſks, &c. expoſed to the froſt. A A A is the water-way; B the plug or valve, that opens and ſhuts the water-way; and C is the ſpindle, joined to B on the contrary ſide to that deſcribed in Fig. 1, and opens and ſhuts the plug by its *vice verſâ* motion. *e e* is a ſhoulder, before which is a part turned with a ſcrew, at E, which ſcrew may be ſcrewed into a veſſel of wood, and, by having a leather ring, or flanch, between the wood (or ſide of the veſſel), and the ſhoulder *e e*, it will readily be made water-proof, by ſcrewing cloſe the ſhoulder; the plug, or valve, B, will then open and ſhut the water-way A A A on the inſide of the ciſtern,

or

Fig. 1.

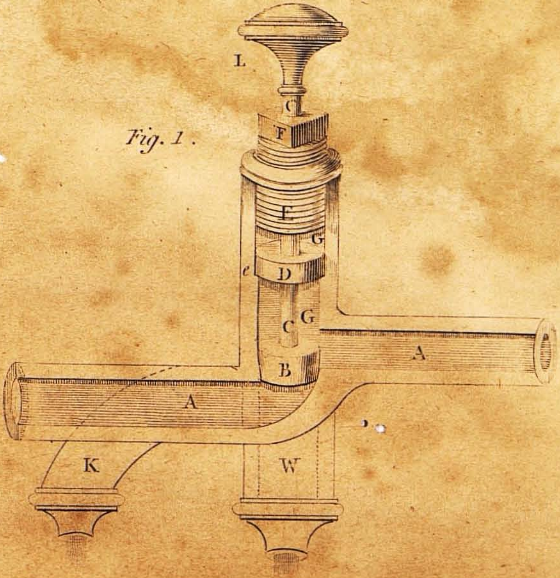


Fig. 2.

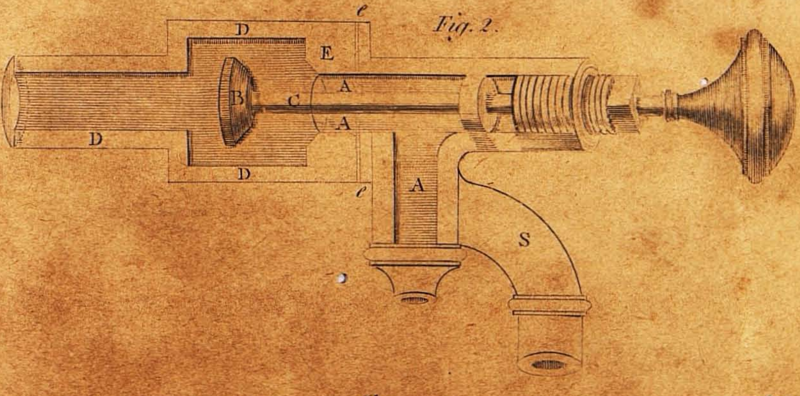


Fig. 3.

or caſk, &c. where the fluid is retained; and as the ſaid water-way will be always left empty, the ſpindle C, or the plug, or valve, B, cannot at any time be ſet faſt by the froſt, without the fluid within the ciſtern, or caſk, ſhould be congealed ſo long as the cock, which would then prevent its being opened. The noſe, or ſnout, of theſe cocks may be made in any ſhape, according to the different ſituations in which they are fixed, ſuch as K or W, Fig. 1. A or S Fig. 2. &c. D D D in Fig. 2. is a boſs, or braſs, which may be uſed when the cock is applied to the end of a pipe, or into a lead ciſtern, where it will be required to be ſoldered into the boſs; the cock may be ſcrewed at pleaſure in or out, and the boſs left in its place.

LV. Specification of the Patent granted to Mr. John Wilkinson, of Broſeley, in the County of Salop, Ironmaſter; for his Invention of a new Method of making Caſt Metal, or Pig Iron, from the Ore, for the Purpoſe of manufacturing it into Bar or any Sort of malleable Iron.

WITH A PLATE.

Dated June 2, 1794.

TO all to whom theſe preſents ſhall come, &c. Now KNOW YE, that, in compliance with the ſaid proviſo, I the ſaid John Wilkinſon do hereby declare, that my ſaid invention of a new method of making caſt metal, or pig iron, from the ore, for the purpoſes of manufacturing it into bar or any

any ſort of malleable iron, is deſcribed in the plan and deſcription thereof hereunto annexed. In witneſs whereof, &c.

Inſtead of melting the ore with additions, in furnaces of thirty to ſeventy feet high, as in the preſent method; my improvement, or invention, conſiſts in uſing low erections, not exceeding ten feet high, of a form either circular, oblong, or ſquare; in which any kind of ore or fuel may be ſmelted, and in which a ſtrong blaſt is introduced at two or more places called *twires*, which are varied in number, as the nature of the ore and fuel may require.

Any workman in the preſent method may, from this deſcription, alter his furnace to the quality of his metals. A drawing of two, with three wires, is given as a ſpecimen, which may be altered in height and dimenſions, with addition of twires, as to the workman may appear needful.

References to the Furnace, No. I.

(See Plate XXIII. Fig. 1.)

A. Caſt-iron plates, forming the outſide of the furnace.

B. The luting, or inſide walls, made of ſand, ſtone, fire-brick, or any other material ſuitable for the purpoſe,

C. Cavity for fuel, and the ore to be ſmelted.

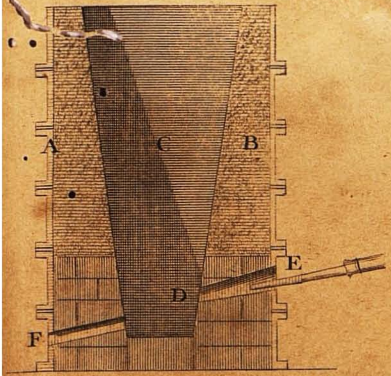
D. Twire holes, through which the blaſt is admitted into the furnace.

E. The blowing pipe, by which the blaſt is brought to the furnace.

F. The tap-hole, or vent for the metal.

N. B. The ſame deſcription is applicable to the furnace, No. II, (Plate XXIII. Fig. 2.) varying in no other particular than in form or ſhape, the one being oblong, and the other circular.

Vertical Section



Vertical Section

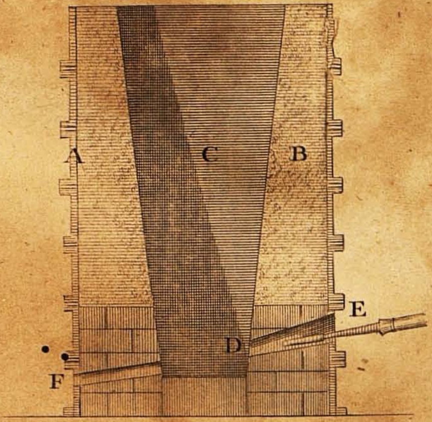
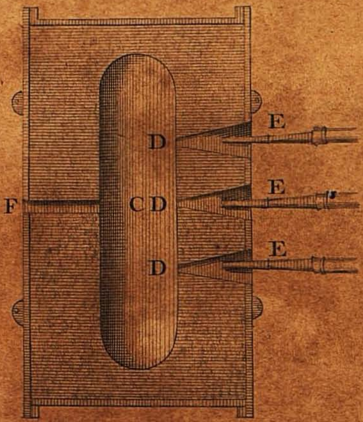


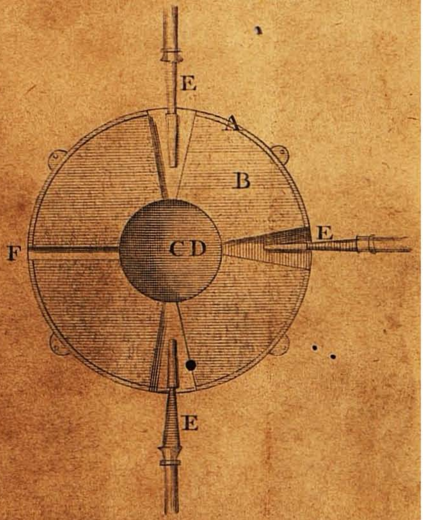
Fig.1.

Fig.2.

Horizontal Section



Horizontal Section



LVI. Specification of the Patent granted to Mr. Charles William Ward, of Hatton-Garden, Middlesex; for his Method of changing the Smoke, or Vapor, arising from the Combustion of many Kinds of Substances, into various useful Materials.

Dated March 15, 1792.

To all to whom these presents shall come, &c. Now know ye, that I the said Charles William Ward, in compliance with the proviso in the said letters patent contained, do hereby describe and ascertain the nature of my said invention of a method of changing the smoke, or vapor, arising from the combustion of many kinds of substances into various useful materials, according to the substances burnt, as follows. All smoke, or vapor, from the combustion of different bodies, is capable of being decomposed or condensed; but as the vapors, according to the substance they proceed

from, require to paſs through cold water, the ſteam of boiling water, or to be confined ſome time in cold veſſels, before they can be condenſed, the change cannot be effected by any method hitherto known, becauſe none of them are capable of making the vapor paſs through water, or of confining it long enough for it to condenſe, without choking up the draught of air neceſſary for the burning of the fires. My invention ſupplies this defect, by making a conſtant draught from the fires, and cauſing the vapour to paſs through, or be retained in, proper veſſels a ſufficient time for it to condenſe; this is effected by connecting the aperture of the chimney, or chimneys, with the condenſing veſſels, or chambers, by means of tubes or pipes; then is to be placed, either between this conection, or behind the condenſing veſſels, any machine, or machines, whoſe principle depends upon the known property of all fluids ruſhing in to fill up the vacuum cauſed by their action, that is to ſay, air-pumps, water-pumps, ventilators, bellows, air-machines, &c.; theſe, however different their conſtructions, have all one common principle, and therefore the application of

of them, or others depending upon the ſame principle, to effect the purpoſe above mentioned, will be an infringement upon my ſaid patent; the ſize, number, and conſtruction of the condenſing veſſels, muſt depend upon the vapor to be decompoſed, as ſome vapors are more difficult to condenſe than others, and therefore require a longer proceſs. The apparatus being thus fixed, the ſubſtances to yield the ſmoke, or vapor, are to be ſet on fire under the chimney or chimneys; and the machine, or machines, ſet in motion by either ſteam, engine, water, or horſe-wheel, &c. the vapor will be drawn from the fires by the action of the machine, and made to paſs through the condenſing veſſels, to be decompoſed; there muſt be apertures at the end of the condenſing veſſels, if the pumping machine is placed between them and the chimney, to open and ſhut, for the purpoſe of giving vent to the incondenſable airs, which will combine with the vapors in burning, and paſs with them through the apparatus; if the machine is placed behind the veſſels, there will be no occaſion for thoſe apertures. In witneſs whereof, &c.

LVII.

LVII. On the Means of ſaving a Portion of the Water, commonly expended in Canal Lockage, by ſide Ponds; in a Letter from WILLIAM PITT, Eſq. Surveyor to the Wyrley and Effington Canal Company.

WITH A PLATE.

Pendeford, near Wolverhampton, Oct. 1, 1794.

HAVING been repeatedly informed that a patent is now ſuing out, from the proper office, for the purpoſe of monopolizing the excluſive privilege of erecting canal-locks with ſide-ponds, for ſaving and preſerving certain proportion of the water commonly expended in lockage; I beg leave, through the medium of your work, to inform the public, that the idea of ſaving part of the water by ſuch means is neither novel, nor at all a ſecret. For this purpoſe I herewith ſend you a drawing and deſcription of a lock upon ſuch principles. If the lock, propoſed by the gentlemen alluded to, be different

different in principles from that here described, I have to beg their pardon; this paper will then have no reference to them. I wish to have it understood, that I do not by any means claim the invention, the general principle of it having been promulgated and discussed long before I had any thoughts upon the subject; though perhaps the particular application of that general principle may not be void of novelty.

In a conversation I had a few days ago with Mr. Jessop, at Lichfield, on this subject, he informed me that the idea is at least an hundred years old, and has been repeatedly executed; and that the reason it has been abandoned was principally the delay occasioned in passing locks of that kind; it is very probable this objection would be in a great measure obviated by the following construction.

A (Plate XXIV.) the chamber of the lock, B the upper, C the lower canal: at D is proposed a culvert, or round arch, through the lower part of the side wall; this culvert being constructed within

the water, will not be liable to blow. E F, walls or piers, of the ſame materials with the lock walls, with openings through their upper part, to communicate with the ſide ponds P 1, P 2, P 3; in each of theſe openings are to be fixed, and cloſely fitted, two ſliding valves, the inner one ſolid, as at G, the outer one with an opening and ſolid bottom, as at H; theſe valves to be conſtructed ſo as to be drawn with a winch or windlaſs, in the ſame manner with the gate-valves.

In order to explain the effect of theſe ſide ponds, I will ſuppoſe the whole fall of the lock to be nine feet, and the ſide ponds each to occupy a ſpace, in proportion to the ſuperficies of the inſide of the lock, as thirteen to two; then the pond P 1 muſt be conſtructed with its bottom two feet ſix inches below the top water of the upper pond; P 2 muſt be two feet two inches lower than P 1; and P 3, two feet two inches lower than P 2; the effect will be as follows.

The lock being filled for the boat paſſing down, the boat incloſed, and gate ſhut, the inner valve

at

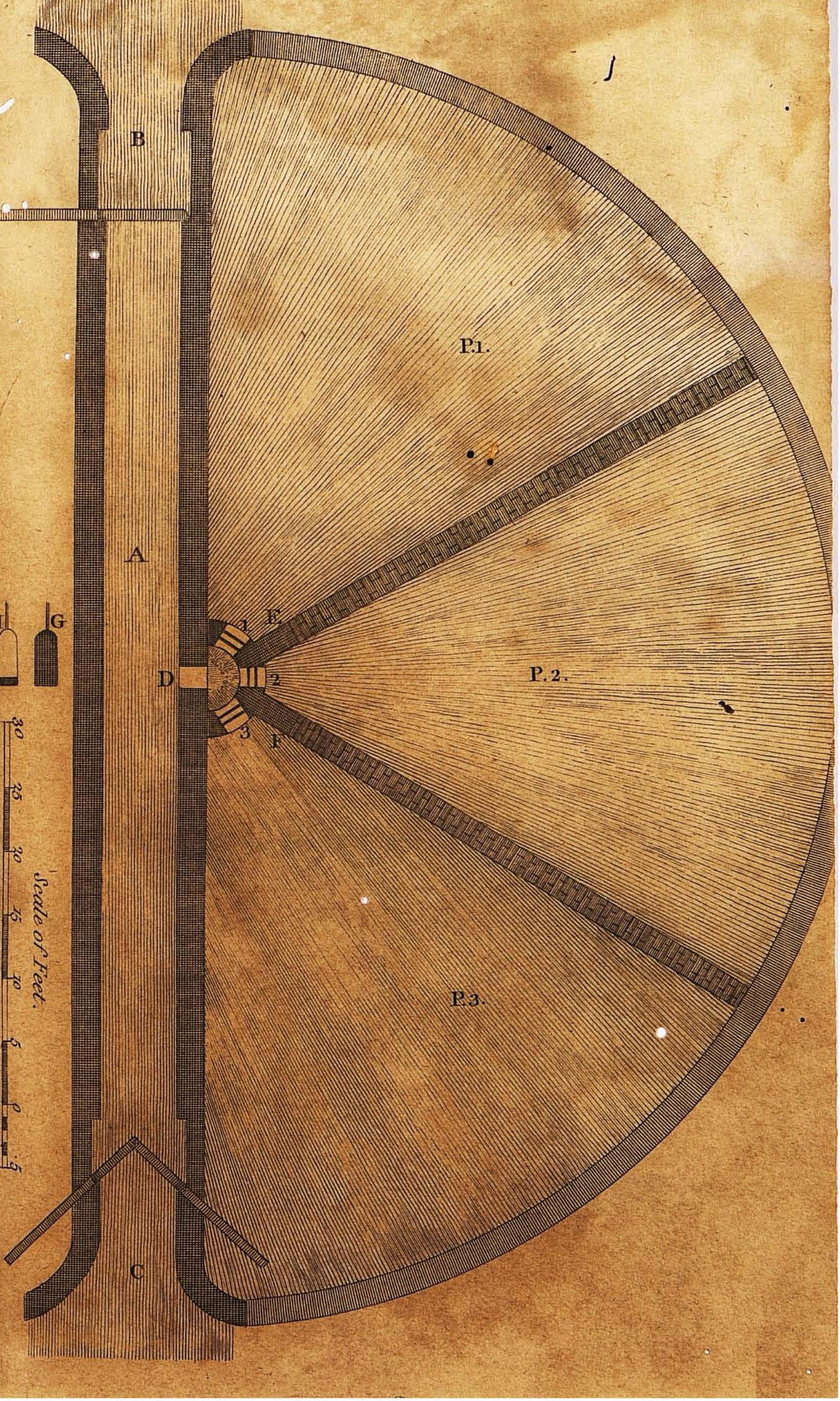
at 1 is to be drawn, when twenty-ſix inches depth of the upper water within the lock will immediately ruſh through the open part of the outer valve into the pond P 1, (which will contain it in a depth of four inches,) and it will be retained there by the ſolid bottom of the valve H: the inner valves at 2 and 3 are to be immediately and ſucceſſively drawn each, with the ſame effect; then, the lower gate-valve being drawn, the boat paſſes into the lower canal in the uſual way, with the loſs only of two feet ſix inches of water. When the lock again wants filling, the outer valves are to be drawn ſucceſſively, but in the retrograde order of 3, 2, 1; by which means ſix feet ſix inches of water will be returned into the lock, and two feet ſix inches only wanted from the upper canal; thus $\frac{13}{18}$ of the lock of water is ſaved, and $\frac{5}{18}$ only expended.

But, to prevent delay, perhaps a more ſimple conſtruction, though attended with ſomewhat leſs ſaving, may be preferable; in which caſe, a ſingle ſide pond, four times the ſuperficies of the inſide of the lock, its bottom five feet below the top

water of the upper canal, will produce the following effect: the inner valve being drawn, four feet of the upper water will immediately rush through the opening of the outer valve into the side pond, (which will contain it in a depth of one foot,) and be retained there by the solid bottom of the outer valve; then, the boat having passed in the usual way, the side pond will fill four feet of the bottom of the lock. In this case, in which the delay will be very trifling, if properly constructed, $\frac{5}{9}$ of the water is expended, and $\frac{4}{9}$ saved.

In order to render the delay as little as possible, it is absolutely necessary to bestow the greatest attention to the following particulars. First, that the centre of the lock, and the centre of the side pond, be as near each other as possible. Secondly, that the funnel of communication, between the lock and the side pond, be as short and as roomy as may be. Thirdly, that the valves be of good size; with due attention to which particulars, it is not doubted but more than one third of the water may be saved, with less than half a minute's delay in each passage, and at a very trifling additional expence.

Another


B
P.1.
A
H
G
E
1
D
2
P. 2.
3
F
Scale of Feet.
30
25
20
15
10
5
P.3.
C

Another advantageous effect will be produced, by constructing the flood wears of the canals to discharge themselves into the side pond; by which means the side pond will become a reservoir to the lock; and the lock may often be filled from it, without drawing a single drop of water from the upper canal.

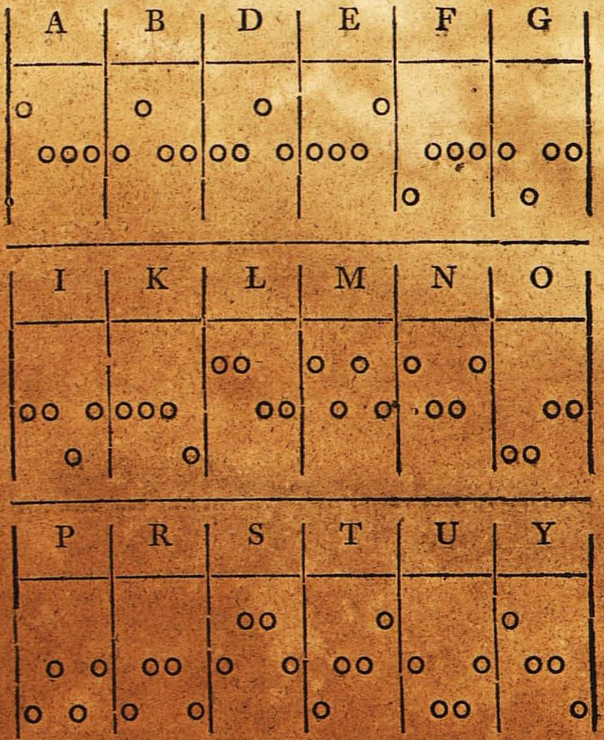
As the side ponds may be wholly formed of earth, the additional expence of constructing a lock upon this principle will be inconsiderable, and the delay (if due attention be had to the above particulars) very trifling; it is believed to be an object well worthy the attention of all persons interested in canals, and that the idea may remain free and open for fair trial is the purport of this paper. I am, &c.

WILLIAM PITT.

LVIII. Defcription of a nocturnal or diurnal Telegraph. Invented and communicated by T. N. Efq.

FOR a *nocturnal* telegraph, let there be four large patent reflectors, lying on the fame plane, parallel to the horizon, placed on the top of an obfervatory. Let each of thefe reflectors be capable, by means of two winches, either of elevation or depreffion, to a certain degree. By elevating or depreffing one or two of the reflectors, eighteen very diftinct arrangements may be produced, as the following fcheme will explain *.

* Each reflector, after every arrangement, muft be reftored to its place.



For the ſake of example, I have made the above arrangements anſwer to the moſt neceſſary letters of the alphabet; but alterations may be made at will, and a great number of changes produced, without any addition to the reflectors. In the firſt obſervatory there need only be a ſet of *ſingle* reflectors, but in the others each reflector ſhould be double, ſo as to face both the preceding and

ſubſequent

ſubſequent obſervatory; and each obſervatory ſhould be furniſhed with two teleſcopes. The proper diameter of the reflectors, and their diſtance from each other, will be beſt aſcertained by experience. On mature deliberation I have fixed on *four* reflectors *, as the number that appears to unite ſimplicity and perſpicuity.

To convert this machine into a *diurnal* telegraph, nothing more is neceſſary than to inſert, in the place of the reflectors, gilt balls, or any other conſpicuous bodies.

The author cannot conclude without ſubmitting to the conſideration of government †, whether it would not be a deſirable object to eſtabliſh a communication of this kind between London and Dublin, *viâ* Donaghadee and Port Patrick.

* Either *three* or *five* might anſwer the purpoſe, but for ſeveral reaſons the number four is preferred.

† Would not ſuch a communication be equally deſirable to the lottery-offices?

LIX. Defcription of a Tide-Wheel, to be ufed for any kind of Mill or Machine; by Mr. ROBERT LESLIE, Watchmaker, of London.

WITH A PLATE.

THIS wheel is reprefented in Plate XXV. in which the fame letters anfwer both to the fection and the plan. A is the fhaft of the water-wheel, which ftands perpendicular, and turns on the gudgeon L. BB, the wings of the wheel, which are made like thofe of a fmoke-jack. CC, a circular box, in form of a drum, which furrounds the wheel. DDDD, a projection round the top of the box, or, in other terms, the box widened at the top. EE, two folding-doors, which open and fhut with the tide, the one next the current is preffed in, againft the poft F, and the one from the current preffed out, fo as to form part of the

circle; when the tide turns they both change to the oppofite pofition, as reprefented by the dotted lines. G G G G are four wings, projecting from the circular box; their ufe is to fupport the box, and to collect the current of the tide into a narrow fpace, by which its velocity may be much increafed.

H is the furface of the river, which muft, at low water, be as high as the top of the box, by which means there is always the fame quantity of water acting on the wheel; for, after the furface of the water is above the top of the box, the water paffes over without producing a greater effect (even if it fhould rife many feet) than when it is juft level with it. I is the bottom of the river; if the natural depth of the river fhould not be fufficient, that part may be made deeper.

The water is let into the circular box, by the current preffing in the door E, till it ftops againft the poft F; which makes an opening from D to F, at which the water enters, and defcends to the bottom, and is let out there at the door K. When the tide

tide turns, the oppoſite doors, both at top and bottom, (alſo marked E and K,) are opened, and the former ones are ſhut, by which the water is made to deſcend as before, and turns the wheel the ſame way with both ebb and flood tide.

The advantages this wheel has over all others turned by the tide are, Firſt, that, if intended for mills, it is more uniform in velocity, as there is always the ſame quantity of water acting on it.

Secondly. That it is made to turn the ſame way with both tides, in a much more ſimple manner than any other.

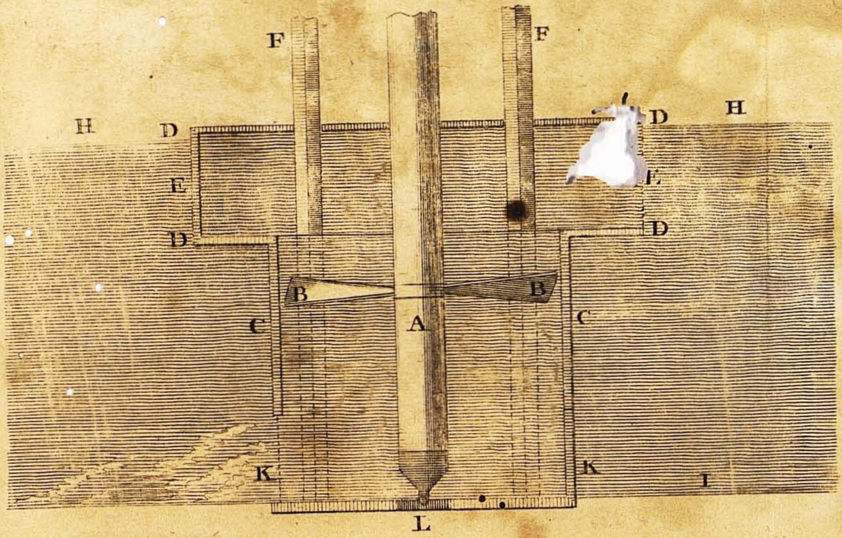
Thirdly. That it turns horizontally, which is much eaſier for all heavy wheels than vertically; and the perpendicular ſhaft may be carried to ſuch a height as to admit the ſpur-wheel, or whatever elſe may be wanted, to be intirely above the water.

Fourthly. That the velocity of the wheel, in proportion to that of the tide, will be greater than any other, and do away the neceſſity of large and

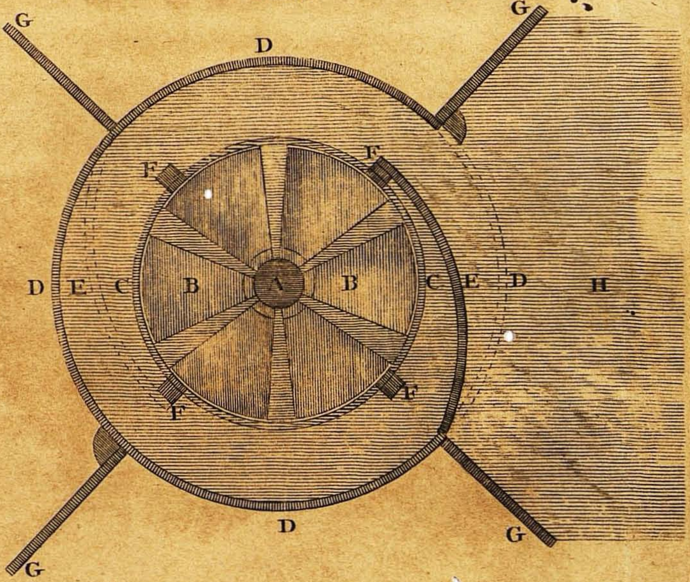
ſmall wheels to produce a quick motion, and conſequently the friction of ſuch large and ſmall wheels.

Laſtly, it is perhaps cheaper than any other that can be erected, to anſwer the ſame purpoſe; and, if the box and ſhaft are laid down on the ſide, inſtead of ſtanding perpendicular, and the tide let to paſs in at one end, and out at the other, though it will turn the wheels different ways with the ebb and flood tide, it will perhaps be better than any other wheel, where cranks are uſed, to raiſe water, ſuch as at London-bridge, &c. as the velocity would be quite ſufficient without cog-wheels and wallowers.

Section



Plan



LX. Method of curing Butter practiſed in the Pariſh of Udny, and its Neighbourhood.

From the general View of the Agriculture of the County of Aberdeen; drawn up, for the Conſideration of the Board of Agriculture, by JAMES ANDERSON, LL. D.

THE following mode of curing butter is practiſed by ſome in the pariſh of Udny, and that neighbourhood, which gives to their butter a great ſuperiority above that of others.

Take two parts of the beſt common ſalt, one part of ſugar, and one part of ſaltpetre; beat them up together, and blend the whole completely. Take one ounce of this compoſition for every ſixteen ounces of butter, work it well into the maſs, and cloſe it up for uſe.

I know

I know of no ſimple improvement in œconomies greater than this is, when compared with the uſual mode of curing butter by means of common ſalt alone. I have ſeen the experiment fairly made, of one part of the butter made at one time being thus cured, and the other part cured with ſalt alone: the difference was inconceivable; I ſhould ſuppoſe that, in any open market, the one would ſell for thirty *per cent.* more than the other. The butter cured with the mixture appears of a rich marrowy conſiſtence, and fine colour, and never acquires a brittle hardneſs, nor taſtes ſalt; the other is comparatively hard and brittle, approaching more nearly to the appearance of tallow, and is much ſalter to the taſte. I have eat butter cured with the above compoſition, that had been kept three years, and it was as ſweet as at firſt; but it muſt be noted, that butter thus cured requires to ſtand three weeks or a month, before it is begun to be uſed. If it be ſooner opened, the ſalts are not ſufficiently blended with it; and ſometimes the coolneſs of the nitre will then be perceived, which totally diſappears afterwards.

The

The pernicious practice of keeping milk in leaden veſſels, and ſalting butter in ſtone jars, begins to gain ground among ſome of the fine ladies in this county, as well as elſewhere, from an idea of cleanlineſs. The fact is, it is juſt the reverſe of cleanlineſs; for, in the hands of a careful perſon, nothing can be more cleanly than wooden diſhes, but, under the management of a ſlattern, they diſcover the ſecret, which ſtone diſhes indeed do not.

In return, theſe latter communicate to the butter, and the milk, which has been kept in them, a poiſonous quality, which inevitably proves deſtructive to the human conſtitution. To the prevalence of this practice, I have no doubt, we muſt attribute the frequency of palſies, which begin to prevail ſo much in this kingdom; for, the well known effect of the poiſon of lead is, bodily debility, palſy,—death!

LXI. Conclusion of Mr. Massey's Treatise on Saltpetre.

(FROM P. 340.)

THE author of this treatise once formed a nitre bed with great care and exactness, and, at the end of a year, expected to have reaped the fruits of his labour, but therein he was totally disappointed; the leys that he drew from these earths afforded him no crystals of this salt; upon which they were thrown aside as useless. A year or two after he took it into his head to make a second trial of them, and then found they answered his purpose extremely well; which he could only attribute to their being more perfectly putrefied, as they had been secluded from the air the whole time. This gave him the first idea of the use and necessity of putrefaction, and made too strong an impression upon his mind to be easily erased.

With

With earths thus duly matured, we can ſcarcely fail of ſucceeding in this buſineſs as well as our neighbours; yet there may be reaſons for our declining it. The large quantities of earth that muſt be elexiviated to obtain a ſmall portion of saltpetre, it muſt be owned, afford no very tempting proſpect; and the fears of not finding a ſufficient quantity of wood-aſhes in this country may have ſtill greater weight. The labour of collecting theſe earths, it is certain, cannot be ſmall; yet may the value of this commodity fully pay the price of it, when brought to a good market, which it is likely to find in England. In reſpect to wood-aſhes, they may reaſonably be judged to be leſs plentiful in this than in other countries, where wood is the only fuel. But, where potaſh is made in conſiderable quantities, as in many of our counties, there certainly can be no ſcarcity of them; and, if their place may be ſupplied by another commodity, equally cheap, and eaſily procured, we can never find any real want of them. This is foreign potaſh, which we find recommended in a ſmall work, not long ago publiſhed, by order of the King of France, by ſome of the moſt eminent

 chemiſts,

chemifts, as far preferable to wood-afhes, upon many accounts.

It has been before obferved, that Glauber fometimes threw all forts of dung into a large wooden veffel, and, when they had completed their putrefaction, percolated a fixt alkaline folution through them; which furnifhed him with a ley of the famé kind and nature with that drawn from nitrous earths and wood-afhes. This, we may prefume, gave occafion for thefe ingenious gentlemen to make fome experiments this way, the refult of which they have given to the public. We tried this method many years ago, with fome fuccefs; but found it depended upon the maturity of the materials, which indeed may be collected from Glauber. What the French writers have faid, upon this fubject, we fhall give in a poftfcript; in order to remove every objection againft our attempting to make faltpetre in England, upon account of the fcarcity of wood-afhes. This difficulty being got over, we truft that nothing will remain, but to give fuch an account of the practical method of making faltpetre as may be relied upon,

upon, and be ſufficiently explicit, to prevent falling into any errors.

The ſaltpetre-makers at Paris chiefly make uſe of the rubbiſh of old houſes, the ruins of old vaults and cellars, &c. this they reduce to a coarſe powder, and, having ſcreened it, proceed as follows. They provide a number of ſmall open tubs, which they prefer to large ones, upon account of their being more eaſily moved and emptied of the materials. Theſe they place upon ſtillages, about two feet high, and in ſuch a manner, that one veſſel may receive the ley that runs from two of them. In each tub, near the bottom, is fixt a ſpiggot and fauſet; and, to prevent the wood-aſhes from choaking the latter, a parcel of the round earth is thrown in firſt, and the aſhes upon it. They then add the remainder of the earth, in the proportion of two buſhels of the latter to one of the former. They throw the earth in lightly, that the water may more readily paſs through it, and they hollow it at top, that it may more conveniently receive it. They have different numbers of theſe tubs, but generally twenty-four, which

they place in three rows, eight in each; and into each tub they throw three bushels of wood-ashes, and six of earth. Ten *demiqueus* * of water, being passed through the first row of eight tubs, are poured upon the second, and afterwards upon the third; and now the first row of eight tubs, being emptied of the earth and ashes, is replenished with fresh materials, and the ley, which has passed through the three rows of eight tubs, is passed through this likewise. Having thus passed through four rows of eight tubs, and been reduced to two *demiqueus* by the absorption of the materials, it is carried to the boiler under the name of *le cuite.*

Such is the process when a new work is erected; in an old one, only six *demiqueus* of water are passed through the three rows of eight tubs, which are filled with fresh materials every day. The lixivium is carefully scummed, during the boiling, and, when it is so far advanced that a pellicle begins to appear upon the surface, a workman is

* A *demiqueu*, as far as we can learn, contains about ninety gallons.

constantly

conſtantly employed, with a perforated ladle, to take out the marine ſalt, which now begins to form, and fall to the bottom of the boiler; this, being thrown into a wiſket, drains into the boiler again. When the lixivium is ſo far evaporated that a drop of it will congeal upon a piece of cold iron, it is taken out, and thrown into a tub, for the remainder of the marine ſalt, and other dregs, to ſettle; and, after ſtanding about half an hour, it is drawn off, whilſt yet warm, into ſhallow copper pans, and ſet in a cool place for the ſaltpetre to cryſtalliſe. The produce of this operation is generally about one hundred and thirty pounds of a brown ſort of ſaltpetre, which is ſold to government for three-pence halfpenny per pound, and carried to the arſenal to be refined.

The liquor remaining in the baſons, when the ſaltpetre is cryſtalliſed, is called *eau mere*, or mother water, and is poured upon the earths in ſmall quantities, when diſpoſed in the tubs for elixiviation; though ſome makers think it beſt to dilute it with water, and percolate it through a freſh bed of wood-aſhes. The earths, when diſcharged from the

the tubs, are thrown aſide to dry under an hovel, and, when dry, are ſpread about a foot thick, to receive the ſcummings, *eau mere*, putrid urine, or any other putrid liquor they can get to throw upon them, and in a few months, we are told, are fit for uſe a ſecond time; particularly, if now and then turned over. To improve the colour of this ſaltpetre, and to cleanſe it ſtill more from the marine ſalt, two thouſand weight is thrown into a large boiler, with one *demiqueu* of water, in which it diſſolves, and, in the courſe of the boiling, another *demiqueu* is added by pailfuls, which, every time it is thrown in, raiſes a thick ſcum that is carefully removed; and now, the evaporation being pretty far advanced, and the marine ſalt taken out as before, a large pitcher of whites of eggs, or of a ſolution of iſinglaſs, or of Engliſh glue, is poured in, and well ſtirred up in it, which raiſes a thick black ſcum, and is taken off with it; but, before the whites of eggs, &c. are thrown in, the boiling liquor is cooled, by adding a pail-ful of cold water. The lixivium being thus clari-fied, is treated as before.

The

The *eau mere* of this operation, being boiled again, yields a ſaltpetre of the ſame colour with the firſt; and ſome ſaltpetre goes through a third operation of the ſame kind, to give it a greater degree of purity. The baſons, in which the ley is ſet for the ſaltpetre to cryſtalliſe, are cloſely fitted with wooden covers, to prevent the too free entrance of the air, which, by cooling the liquor too ſoon, would not admit the cryſtals to form of ſo large a ſize. The cryſtallization is generally completed in two or three days; and about one-fourth part is ſuppoſed to be loſt in refining.

Such is the method of making ſaltpetre in Paris, as tranſmitted to us by thoſe whoſe knowledge and veracity cannot be called in queſtion; in which we can find no myſtery, or difficulty, or any expence that can reaſonably deter us from engaging in undertakings of this kind. The Engliſh will, in all probability, be obliged to employ other earths than the rubbiſh of old houſes, which is the caſe with all our neighbours that do not live in large and populous towns; of which earths, we flatter ourſelves, we have given a full deſcription.

And

And here we cannot help obſerving one encouragement which an adventurer in this way will always have, viz. that whatever materials he may lay together for this purpoſe, if they do not anſwer his end as a ſaltpetre-maker, will always find their value with the farmer.

Wood-aſhes are certainly an article of great importance; but, ſhould they ever be found wanting, their deficiency may be ſupplied as we have hinted above. Thoſe who may engage in theſe undertakings, with the leaſt riſque of expence, are certainly the potaſh-makers in this kingdom, who, being provided with the neceſſary utenſils, can only want a proper earth to begin their operations, which, in caſe they are unprovided, we have ſhewn, may be eaſily procured in the ſpace of a year or two, by mixing up their dunghills with fallen lime, and ſuffering them to lie till they are perfectly putrefied.

The author, ſome years ago, cauſed a trench to be dug in an open field, ten yards long, one yard wide, and one foot deep. This he half filled with good muck from a dunghill, and covering it up with

with the ſoil, mixt with one-third the quantity of fallen lime, left it to take its fate. The weeds were plucked off as they ſprouted up, and it was twice turned over, in the ſpace of the year; at the end of which, this earth, being elixiviated with wood-aſhes, afforded him fair cryſtals of ſaltpetre. In ſo eaſy a manner may a nitrous earth be prepared.

We ſhall add no more, than that the crofters ley, after it has performed its office of carrying off the foul oily parts of linen, or linen-yarn, and which is generally ſuffered to run waſte, may here be certainly uſed to good advantage: and that we would adviſe every one, who is inclined to try experiments in this way, not to make them with leſs than one buſhel of earth, and half this quantity of wood-aſhes, from which two gallons of ley may be drawn, which, being boiled down to about a pint, may indicate the ſucceſs, if any is to be expected.

P. S. *On the uſe of potaſh in making of ſaltpetre,* tranſlated from the French.

Thofe who have attended to the former part of this work will doubtlefs be fenfible of the ufe of wood-afhes in the formation of faltpetre, and that it is impoffible to make this falt without them, or fomething of a fimilar nature; remembering that faltpetre, properly fpeaking, is a compofition of two fubftances, united and combined in the fame proportion, which are, the nitrous acid, and a fixt alkali. That the faltpetre formed in fome earths, for the moft part, contains only one of thefe two principles, the nitrous acid; which, being combined with a calcareous earth, forms a nitre with an earthy bafis, from which the earth muft be precipitated, and a fixt falt introduced in its ftead, to convert it into a true faltpetre.

Wood-afhes, upon account of the fixt alkali they contain, are very proper for this purpofe, and the faltpetre-makers, by mixing thefe afhes with the earths they elixiviate, perform a complex operation in chemiftry; they decompofe one falt, and compofe another. But as it is the fixt alkali, in the wood-afhes, that alone acts upon the nitre

nitre with an earthy baſis, it follows, that if we extract this alkali from them, by elixiviation and evaporation, it will be brought into a ſmaller compaſs, and ſupply the place of a larger quantity of wood-aſhes.

The fixt alkali, or ſalt extracted from wood-aſhes, is known, in commerce, by the name of *potaſh*, and is made in large quantities in Sweden, in Denmark, and in all the northern parts of Germany; nor is it hard to procure potaſh of a good quality in France, ſo that we have always a ſimple, eaſy, and cheap, method of ſupplying the place of wood-aſhes in thoſe provinces where they are ſcarce or dear, and the buſineſs of ſaltpetre-making contracted upon that account. And we can aſſure the reader that, even where wood-aſhes are in the greateſt plenty, potaſh will be found far preferable to them, for the following reaſons: In the firſt place, becauſe the wood-aſhes uſed by the ſaltpetre-makers in large towns are generally the refuſe of other trades, and contain little or no fixt alkali. Thoſe that are uſed by the ſaltpetre-makers in Paris are of this ſort, and often afford,

 upon

upon elixiviation, only a little Glauber's ſalt, tartar of vitriol, and, above all, large quantities of marine ſalt, of which the tartar of vitriol alone contains any fixt vegetable alkali that can furniſh the baſis of ſaltpetre, or be of any uſe in decompoſing the nitre with an earthy baſis. Secondly, wood-aſhes taking up one-third of the room in the veſſels in which the lixivium is made, there is, of courſe, leſs room for the earth; and the ſaltpetre muſt conſequently be leſs in proportion. Thirdly, wood-aſhes, being very porous, abſorb a large quantity of water, which they obſtinately retain, and this water holds a quantity of ſaltpetre in ſolution, which is a clear loſs, in proportion to the quantity of water they contain. Fourthly, wood-aſhes bear a very conſiderable price in moſt parts of France, and we are certain this price is ſuperior to that of potaſh, conſidering the portion of fixt alkali that they reſpectively contain. Fifthly, theſe aſhes are commonly impregnated with many groſs parts, and much dirt and filth are extracted from them, which muſt not only injure the ſaltpetre, but obſtruct its cryſtallization.

All

All theſe things being conſidered, with the practice of the Swedes, and the ſucceſs of our own experiments, we judge ourſelves authoriſed to adviſe all thoſe who are employed in making ſaltpetre, to place but a few wood-aſhes at the bottom of their tubs, to ſerve by way of filtre, and to ſupply their place with potaſh, in the following manner. When the tubs are filled with earth, the quantity of potaſh we mean to employ is to be laid upon it, and we are to proceed to elixiviate it in the uſual way. The water will immediately diſſolve the potaſh, which, filtering through the earth, will decompoſe the nitre with an earthy baſis, and convert it into ſaltpetre; and, if the potaſh has been in a juſt proportion, none of the former will be left behind. It is not neceſſary to lay the potaſh upon the earth in all the tubs, but only upon thoſe of the firſt row; becauſe, theſe earths being waſhed ſucceſſively by three waters, the leſs potaſh will remain in them.

Nothing can be ſaid, preciſely, of the quantity of potaſh to be laid upon any given quantity of earth;

earth; this depending upon the condition of theſe earths, their richneſs, and the quantity of nitre with an earthy baſis that they contain, and, in ſhort, upon many other circumſtances which it is impoſſible to foreſee. We can only, therefore, lay down ſuch rules as may enable the ſaltpetre-maker to judge what quantity of potaſh he ought to employ, according to the ſtate in which he finds theſe earths. For this purpoſe, let him diſſolve one part of potaſh in two parts of water, and either filter the liquor, or let it ſtand till it is clear, and ſet this ſolution aſide; let him then elixiviate ſome very pure nitrous earth, in three or four times its weight of water, and ſet this lixivium likewiſe aſide; and if, upon dropping ſome of the ſolution of potaſh into a glaſs of his ley, he finds the latter grow whitiſh or muddy, he may be aſſured that the precipitation of the earth is not completed, and conſequently, that a ſufficient quantity of potaſh has not been employed; if, on the other hand, the ley remains untroubled, let him drop in ſome of the lixivium drawn from the nitrous earth, upon which, if the potaſh is in too great

great quantity, it will likewiſe turn muddy. Upon the whole, if in neither of theſe caſes the liquor is diſturbed, he may be aſſured the potaſh has been employed in a juſt proportion.

In general it is better to uſe too little than too much potaſh. When too little is employed, it is true that part of the nitre with an earthy baſis will not be decompoſed, but it will be found in the mother water after cryſtallization; and, when a large quantity is collected, it may be elixiviated ſeparately. Inſtead of uſing potaſh in ſubſtance, it may be diſſolved in a given quantity of water; for inſtance, one pound of potaſh in two pounds of water, and three pounds of this liquor uſed in the room of one pound of potaſh. The French miniſtry are ſo deſirous of bringing potaſh into uſe, being ſenſible of the great advantages that muſt reſult from it, that they have ordered the *Régiſtres des poudres* to furniſh the ſaltpetre-makers, and others who may be inclined to take up the buſineſs, with this article, and to take care that it is of the beſt quality.

Thus

Thus far the authors, who have ſet their names to this little piece, and who are no other than Meſſrs. Macquer, Lavoiſier, D'Arcet, Cadet, and Sage.

It is certain that, by percolating a fixt alcaline ſolution though a nitrous earth, *duly matured*, the ſame kind of ley may be obtained with that in common uſe among the ſaltpetre-makers; and that a ſolution of potaſh, of ſome kinds, if not of all, may anſwer this end; but we cannot approve of uſing it in ſubſtance, as is here recommended. By diſſolving it in water, and weighing it, we can know the exact quantity of fixt alkali we employ, and may with great eaſe increaſe or diminiſh it, as we ſee occaſion. The value of foreign potaſh is no where better known than in England, there being, perhaps, no part of the world in which there is a greater conſumption of it, nor where it is ſupplied upon cheaper terms; which circumſtance muſt ſtrongly recommend its uſe.

LXII. Conclufion of the Chevalier de St. Real's Memoir on rendering Leather impermeable to Water.

(FROM P. 354.)

Experiment IX. I cut five flips of leather of different kinds; that I might always be able to diftinguifh them, in the courfe of my operations, I marked upon each of them, with ink, a different letter. That marked A was of the ftrongeft and thickeft cow-leather I could procure, fit for making foles of boots. The flip B was alfo of ftrong cow-leather, but lefs thick than the former, and fit for making foles of common fhoes. The flip C was of that fort of cow-leather which, in Dauphiné, is called *brigady*; fit to make the foles of pumps, or the inner ones of fhoes. The flip D was of cow-leather, in grain, dreffed with fat, fit to make the upper leathers of ordinary fhoes. The flip E was of calf-leather, dreffed in oil, on the flefh-fide; fuch as is ufed for the upper leathers of fhoes for perfons of a higher rank.

A weighed forty-four grains and a quarter, or one hundred and ſeventy-ſeven quarters of a grain. B weighed four hundred and ſixty-four quarters of a grain. C weighed ninety-two quarters of a grain. D weighed one hundred and forty-five quarters of a grain. E weighed one hundred and ſeventy quarters of a grain.

I put all theſe ſlips of leather into a veſſel full of water, the veſſel held about ſix quarts, conſequently the water was more than an hundred times the weight of the leather, and, during the whole time of the experiment, it was at the temperature of from 12 to 14 degrees. (59 to 63½ of Fahrenheit.) The ſlips marked A and B immediately ſunk, and remained at the bottom of the veſſel. Not more than two or three bubbles of air eſcaped from them; but, for a long time, they continued forming upon the ſurface of the leather, where they adhered. The ſlips marked C D and E at firſt ſwam upon the water, but, by means of a braſs grating, placed in the middle of the veſſel, they were kept under it, and at laſt ſunk in the following order, viz. E, after two hours immerſion, and

and the two others after two hours and twelve minutes; all of them were covered with bubbles of air, which adhered to their ſurface.

After having been immerſed three hours, they were taken out and weighed. The following are the reſults. A weighed 236, B 604, C 142, D 206, and E 190 quarters of a grain. Conſequently A had abſorbed 60, B 140, C 50, D 61, and E 20, quarters of a grain of water. And the proportion of water abſorbed, to the original weight of the leather, was as follows: A $\frac{60}{177}$, B $\frac{140}{484}$, C $\frac{50}{92}$, D $\frac{61}{145}$, and E $\frac{20}{170}$.

I then took the water, which was of a yellow colour, out of the veſſel, and put freſh water in its place, into which I put the ſame ſlips of leather. After having remained in it ſixty-nine hours, they were again weighed. A weighed 243, B 630, C 149, D 222, E 231, quarters of a grain. A therefore had abſorbed 66, B 166, C 57, D 77, E 61, quarters of a grain of water. Proportion of water abſorbed, to the original weight of the leather, A $\frac{66}{177}$, B $\frac{166}{464}$, C $\frac{57}{92}$, D $\frac{77}{145}$, E $\frac{16}{170}$.

By

By reducing all these fractions, which express the proportion of water absorbed, to the same denominator, it appears, that after three hours immersion in water A absorbed $\frac{62}{185}$ of its original weight, B $\frac{55}{185}$, C $\frac{100}{185}$, D $\frac{77}{185}$, and E $\frac{25}{185}$. And that after sixty-nine hours immersion A absorbed $\frac{70}{185}$, B $\frac{76}{185}$, C $\frac{114}{185}$, D $\frac{98}{185}$, E $\frac{66}{185}$.

The water in which the leather had been soaked was reddish; having evaporated it in a water-bath, I obtained a residue of the same colour, which appeared to be merely extract of tan, as it precipitated iron, from a solution of vitriol, of a black colour, as in the eighth experiment of the first section.

Nothing can be more important to the art of the currier than the experiment I have just related, as it not only shews the different qualities of each kind of leather, but it also puts us in the way of discovering the causes of them, their defects, and the means of remedying those defects; as will appear by the following observations.

First. It follows, from the above experiment, that there is no kind of leather which does not absorb more or less water: in penetrates into its

pores,

pores, diſſolves the extract of tan, and takes its place. It therefore would be of great advantage that all the operations of the currier ſhould be preceded by ſoaking the ſkins, for a conſiderable time, in running water, to diſſolve all the extract of tan that may be contained in them. The duration of this immerſion cannot be determined, it ſhould be regulated by experiment; that is to ſay, the ſkins will be known to have been ſoaked along enough, when, after putting ſome pieces of them in a veſſel of water, they are found not to give any colour to it.

Secondly. It follows, that the leather which is moſt thoroughly tanned is alſo the moſt impermeable to water. The ſtrong ſole-leather, which has been a whole year in tanning, imbibed much leſs water than the cow-leather dreſſed with fat, although we might have ſuppoſed that the fat, with which it was impregnated, would have preſerved it from the action of the water. It is, therefore, principally to the perfection of the tanning that we are to attribute the ſuperior quality of leather. It may alſo be ſuſpected, that all leather, except the

ſtrong

ſtrong ſole-leather, ſtill contains a ſmall quantity of animal jelly, which, although it is not ſoluble in cold water, may grow ſoft and ſwell in it, as indeed really happens to common leather when immerſed in water. The complete extraction of all the animal jelly appears, therefore, to be abſolutely neceſſary, whatever uſe the leather may be intended for.

Thirdly. It follows that the quantity of water imbibed by different kinds of leather, is not in proportion to the time they are immerſed in it. The two kinds of ſtrong ſole-leather, at the end of three hours, had already abſorbed almoſt all the water which they contained at the end of ſixty-nine hours; whereas the calf-ſkin, dreſſed with oil on the fleſh ſide, after three hours immerſion, had not yet abſorbed one-third part of the water with which it was impregnated after ſixty-nine hours. The cauſe of this appears to me to be, that the water cannot eaſily penetrate into that kind of leather, until it has driven the oil out of it. The affinity of water with the fibrous part is, indeed, ſtronger than that of oils; but this latter requires

ſome

ſome time to be diſplaced, which retards the penetration of the water at the beginning of the immerſion. It is to be wiſhed that we could, inſtead of oil, make uſe of a ſubſtance which, at the ſame time that, like oil, it had no affinity with water, ſhould have a ſtronger affinity with the fibrous part of the leather than water. As the affinity here ſpoken of is only an affinity of aggregation, the more ſolid kinds of greaſe might perhaps anſwer the purpoſe.

Fourthly. Nevertheleſs, it appears that the greaſe uſed in currying leather, which is no other than beef-fat, is leſs proper than oil to hinder the penetration of water, ſince the cow-leather dreſſed with fat imbibed $\frac{98}{185}$ of water; whereas the calf-ſkin dreſſed with oil imbibed only $\frac{66}{185}$. But, to be juſt, we muſt attribute this difference to the manner in which the currier applies the fat. He rubs the leather with a kind of mop, dipped into melted fat, moderately warm. It ſeems impoſſible that, by this manner of applying it, the fat can penetrate into the interior parts of the leather; the air contained in its pores oppoſes an invincible ob-

ſtacle

ſtacle to the penetration of it. On the contrary, there is no air in the pores of the wet leather upon which the oil is applied, and the permament fluidity of the oil itſelf alſo facilitates its paſſage into the leather. Conſequently, before we attempt to judge whether oil or fat has the beſt effects upon leather, we ſhould make all circumſtances reſpecting them equal; we ſhould deprive the leather of the air which is in its pores, before we ſoak it in the fat, and we ſhould keep the fat in a liquid ſtate for a conſiderable time. If, therefore, after three or four days immerſion in running water, to drive out the air, the leather was to be ſoaked in melted fat, of the temperature of 60 degrees, (167 of Fahrenheit,) till all the water was evaporated by the heat, there is reaſon to hope that the fat would penetrate into the interior pores of the leather, and render it impermeable to water.

Fifthly. It follows, that the moſt permeable to water, and conſequently the worſt, of all kinds of leather, is the cow-leather, called brigady, of which the ſoles of pumps and thoſe of ſome ſorts of women's ſhoes are made; ſince, in the ſpace of three

three hours, is abſorbed more than the half of its own weight, and in ſixty-nine hours nearly two-thirds. This kind of leather, being too little tanned not to contain a portion of animal jelly, is a true hygrometer, and humanity requires that its uſe ſhould be prohibited. How can delicate perſons, particularly females, preſerve themſelves in rainy weather from wet feet, and from the numerous diſorders they occaſion, if the ſoles of their ſhoes act like a ſponge? To remedy this evil, and to make the vanity of faſhion agree with the care which every one ought to take of his health, it is abſolutely neceſſary that this kind of leather ſhould be better tanned.

Sixthly. It follows, that of all kinds of leather commonly uſed, the leaſt permeable to water is calf-ſkin, dreſſed on the fleſh-ſide with oil, ſince after three hours immerſion in water it imbibed only $\frac{2}{17}$ of its own weight. This is, without doubt, in ſome meaſure, owing to the oil, as I have already obſerved; but the greater degree of compreſſing this leather undergoes, in the operation of currying, alſo contributes to it.

Compreſſion evidently diminiſhes the thickneſs of leather, and increaſes its compactneſs; to aſcertain this, I beat ſome leather with an iron hammer upon a very ſmooth anvil, and I found that beating it produced a permanent contraction of its pores. Leather therefore is, in that reſpect, very much like iron, and thoſe other metals which harden by beating; and conſequently it would be of great advantage to compreſs it before it is uſed.

In conſideration of this property of leather, and of the foregoing obſervations, I made the following experiment.

Experiment XII. I ſelected, with the aſſiſtance of a ſhoemaker, four pieces of leather, of different kinds, and the beſt of their kind that I could procure. One of them was of ſtrong ſole leather; another was of the kind already mentioned, called *brigady*; the third was of cow-leather dreſſed with fat: and the fourth was of calf-leather dreſſed with oil, on the fleſh-ſide. I divided each piece into two, ſo that I had then two ſlips of each kind. I marked each kind, as before, with a different letter; conſequently

quently I had four ſlips, marked with the letters A B C and D. The four correſponding ſlips, being merely to ſerve as objects of compariſon, and not being liable to be miſtaken, were kept without marks. The ſtrong ſole-leather was marked A; the thin ſole-leather, called *brigady*, was marked B; the cow-leather, dreſſed with fat, was marked C; and the calf-leather, dreſſed with oil, was marked D. I ſoaked theſe four ſlips in running-water during the ſpace of eight days; I then took them out, and put them into a veſſel, containing twenty times their weight of water, for eight days more. As this water hardly acquired any colour in that time, I concluded that the extract of tan had been diſſolved, and taken away, by their immerſion in the running-water.

I formed an apparatus of water-baths, placed one in the other, to the number of ſix; and, having put a thermometer in the interior one, I brought the exterior one to boil; I then threw into it, little by little, ſome common ſalt, that it might ſupport a greater degree of heat. This I continued to do, till the thermometer, placed in

the innermoſt bath, indicated exactly 59 degrees, (132¾ of Fahrenheit,) and kept it without alteration at that temperature. I adviſe thoſe, who may be inclined to repeat this experiment, to arm themſelves with patience and courage ſufficient to overcome difficulties; for, it is a very difficult taſk to keep water, for a length of time, at any given temperature under that at which it boils.

I poured out the water from the innermoſt veſſel, and put beef-fat in its place; when it was melted, I took the four pieces of leather, marked A B C D, out of the water, in which I had till now left them, and threw them inſtantly, quite wet, into the melted fat, in which I let them remain forty-eight hours. I then raiſed them an inch above the fat, that they might drain into it; and, when they were become ſo dry as no longer to let any fat fall from their ſurface, I rubbed them with blotting-paper till they ceaſed to ſtain it.

Theſe ſlips of leather were very ſupple, indeed more ſo than they need be for moſt uſes, particularly the ſtrong ſole-leather, which requires a cer-

a certain degree of ſtiffneſs. To ſtiffen them, to increaſe their compactneſs, and to deprive them of all the ſuperfluous fat they might retain, I paſſed them through a pair of rollers, ſuch as are uſed for flattening metals, compreſſing them gently at firſt, and increaſing the compreſſion by degrees. I wiped them carefully, every time they paſſed, that I might take away the fat which the rollers forced from their pores. By this operation the ſlips marked A C and D were become ſmooth and ſhining, like poliſhed wood; the grain of them was extremely cloſe, and their ſuppleneſs and elaſticity were very much increaſed. The ſtrong ſole leather A was reduced to two-thirds its original thickneſs; the cow-leather C to four-fifths; and the calf-leather D to ſeven-eighths. The thin ſole-leather, marked B, could not bear the action of the rollers, its fibres were entirely broken; it was, in ſhort, ſo torn (another proof of the bad quality of this leather), that, being fit for nothing, I threw it away.

The ſlips A C D being thus prepared, I threw them into a veſſel full of water, along with the three

three correſponding ſlips, which I had kept aſide to ſerve as objects of compariſon. All the pieces which I had ſoaked in fat, and preſſed, ſunk immediately to the bottom of the veſſel; the others I fixed under the ſurface of the water.

The ſtrong ſole-leather, marked A, before its immerſion in water, weighed two hundred and thirty grains; the correſponding ſlip, cut off from the ſame piece, weighed one hundred and eighty-one grains. After being immerſed thirty-nine hours, the ſlip marked A weighed two hundred and thirty-eight grains: the weight of the water abſorbed was eight grains: and its proportion to the weight of the leather was $\frac{8}{230}$. The correſponding ſlip, after being immerſed the ſame ſpace of time, weighed two hundred and ſixty-ſix grains: the weight of the water abſorbed was eighty-five grains; and its proportion to the original weight of the leather was $\frac{85}{181}$. By reducing theſe fractions to the ſame denominator, and dividing their numerators one by the other, it appears, that the ſtrong ſole-leather, by being properly

perly impregnated with fat, and compreſſed in the rollers, abſorbs thirteen times leſs water than that which has not undergone thoſe operations. The quantity of water which the firſt abſorbs, and which amounts to about one-thirtieth part of its weight, is ſo ſmall that it does not render it capable of wetting any ſubſtance it may come in contact with, nor does the leather appear wet when taken out of the water; it may therefore be conſidered as almoſt impermeable to it.

The cow-leather dreſſed with fat, marked C, weighed, before its immerſion, one hundred and ſeventy grains; the correſponding ſlip of the ſame leather weighed one hundred and ſixty-ſeven grains. After thirty-nine hours immerſion, the ſlip marked C weighed one hundred and ſeventy-five grains: the weight of the water abſorbed was five grains; the proportion of it to the weight of the leather was $\frac{5}{170}$. The correſponding ſlip, after the ſame time of immerſion, weighed two hundred and nine grains; the weight of water abſorbed was forty-two grains; and the proportion of it to the weight of the leather was $\frac{42}{167}$. By reducing

reducing these fractions to the same denominator, and dividing the numerator of the one by that of the other, it appears that the cow-leather marked C, when impregnated with fat, and compressed absorbs about nine times less water than leather of the same nature, which has not undergone those operations. The small quantity of water absorbed by the first, which amounts exactly to the thirty-fourth part of its own weight, may be considered as nothing, since it does not render the leather capable of wetting any substance it may touch.

The calf-leather, marked D, before its immersion, weighed seventy-two grains. After being immersed thirty-nine hours, it weighed seventy-three grains and three quarters; the weight of water absorbed was one grain and three-quarters; and its proportion to the weight of the leather was $\frac{7}{288}$. On the other hand, the corresponding slip of the same leather, cut from the same piece, (but which had neither been soaked in fat, nor passed through the rollers,) weighed, before being immersed, eighty-nine grains, and, after being in the water thirty-two hours, ninety-six: the weight of water it had absorbed was seven

ſeven grains; and the proportion of the water to the weight of the leather was $\frac{7}{89}$. If we reduce theſe fractions to the ſame denominator, and divide the greater numerator by the leſs, we ſhall find that the calf-ſkin D, when impregnated with fat and compreſſed, abſorbs only one third part the quantity of water that the ſame kind of leather abſorbs when it has not undergone thoſe operations; and as that quantity is ſo very ſmall (it being not ſo much as the one-and-fortieth part of the weight of the leather) as not to render the leather capable of communicating moiſture to any ſubſtance it may touch, it may be conſidered as none.

Theſe experiments, and the preceding ones, equally contribute to demonſtrate, both by way of ſyntheſis and by that of analyſis, that, without making any alteration in the uſual method of tanning, except with reſpect to the thin ſole-leather, it is poſſible to render leather very nearly impermeable to water, by the known operations of currying, provided to them are added compreſſion in rollers, and ſoaking in fat, as before deſcribed. All leather, except the

ſtrong ſole-leather, being dreſſed either with fat or with oil, the additional greaſing and preſſing will not ſenſibly increaſe its price. Two workmen may greaſe and preſs twenty thick hides in a day, which, at 30 ſous a day, will add three livres to the price of twenty hides. The common weight of a thick hide, for ſole-leather, is about forty-four pounds; twenty of them therefore will weigh eight hundred and eighty, and I have found, by many experiments, that they retain about the ſixteenth part of their weight of fat; conſequently they will abſorb about fifty-five pounds, which, at 7 ſous 6 deniers a pound, will add to the price of the twenty hides 20 livres 12 ſous 6 deniers; and twenty hides, which at preſent coſt 743 livres, will then coſt 766. The proportion of this increaſe of price, in a pair of ſhoes, would be ſcarcely perceptible; not to mention that there is great reaſon to believe, that the method of tanning, deſcribed in the firſt ſection of this memoir, would be much leſs expenſive than that commonly followed in the tan-yards, and more advantageous to the manufacturers, by a more ſpeedy return of their capitals; ſo that, upon the whole, the lea-

ther

ther might be delivered to the workman at the ſame price as at preſent.

I have made many comparative experiments, to determine whether leather which had paſſed through the rollers was diminiſhed in its ſtrength. Experiments of that kind are of ſo ſimple a nature, that a particular account of them would be uſeleſs; it is ſufficient for me to ſay, that ſuch leather ſupported, without breaking, weights as heavy as were ſupported by leather of the ſame kind which had not undergone that operation.

LXIII. Concluſion of M. Chaptal's Obſervations on oxygenated Muriatic Acid.

(FROM P. 360.)

THE proceſs of bleaching, by means of the vapour or gas of oxygenated muriatic acid, may be alſo made uſe of to bleach linen and cotton. After many trials made in my laboratory, I reſolved to

 make

make an experiment in the large way, upon ſeveral pieces of undreſſed dimity; and for that purpoſe placed, in one of the rooms of my manufactory, (which room is twenty feet ſquare, and lined with lead,) a large earthen veſſel, in which I put ſix pounds of manganeſe, and twelve of ſmoking muriatic acid. I had previouſly hung in this room one hundred *cannes* of dimity *, which were ſuſpended to, and ſupported by, thin round pieces of wood, fixed into pedeſtals faſtened to the ſides of the room, the doors of which were then cloſely ſhut, and cemented. After twenty-four hours I made ſome openings, to give a gradual vent to the ſuffocating vapours of the oxygenated acid; and at the end of three days the room was in ſuch a ſtate as to permit me to go into it, and to examine my dimity. I found it very ſupple and ſoft to the touch, and rather wet, as cloths are when the air is very damp; at firſt it appeared to me to be completely bleached, but, by a more ſtrict examination, I diſcovered that thoſe parts, which were in contact with the

* A canne is one ell and two thirds, Paris meaſure.

wood

wood on which it hung, had not, in a perceptible degree, loſt any of their original colour; I alſo obſerved, that thoſe portions of the dimity, which were fartheſt removed from the veſſel containing the acid, were leſs bleached than the others. It is, however, eaſy to remedy theſe inconveniences; firſt, by putting a number of veſſels in various parts of the room; ſecondly, by giving motion to the cloth which is to be bleached, ſo that its different parts may be ſucceſſively preſented to the action of the vapour, and conſequently every part be equally acted upon.

Skains of linen and cotton-thread, hung in this atmoſphere of gas, were bleached merely upon their ſurface; I am convinced, therefore, that this method is applicable only to cloths; but, as it is very œconomical, I have no doubt that it will be adopted for bleaching linen and cotton cloth. It would not be neceſſary to make uſe of a room, lined with lead, any place which could be well lined on the inſide with wood, with plaſter, or with cement, would be proper for the operation.

As

As the oxygenated muriatic acid begins now to be used in various arts, and as they derive great advantage from it, I will here mention a simple and œconomical method of preparing it, which in some cases may be adopted.

To oxygenate muriatic acid, nothing more is necessary than to weaken it, and to mix with it some manganese, in a very strong bottle; the quantity of both together must be such that the bottle may not be full. Bubbles are then formed upon the surface of the liquor, and the empty space is filled with a greenish vapour; after some hours the acid may be still more diluted with water, and made use of. It has a sour taste, because it is not fully saturated with oxygene, but it possesses all the powers of oxygenated muriatic acid. This process may be employed when there is not time to put together a distilling apparatus, to procure oxygenated acid by the usual method.

To this memoir I shall add some observations which I have made, upon the action of oxygenated muriatic gas. The manner in which I made them

was,

was, by putting the ſubſtance I wiſhed to expoſe to the action of the gas into a receiver, which I luted to a tubulated retort, placed upon a ſand-bath. The manganeſe and muriatic acid are to be introduced by the tube of the retort, and the gas which is diſengaged fills the receiver, and exerciſes its action upon the ſubſtances therein contained.

Firſt. By being expoſed to this gas, heavy oils grow thick; oil of olives becomes of a white colour, and of the conſiſtence of an ointment: it acquires alſo a greater degree of gravity, ſo that it will no longer float on water; it combines difficultly with fixt or volatile alkali; it ſwells when thrown upon live coals, inflames, and ſmokes very much; if it is expoſed to the air for a length of time, it gradually loſes its whiteneſs and its conſiſtence; the action of a ſtrong light haſtens this effect. Volatile oils, in general, alſo get colour and grow ſenſibly thicker; but the action of the gas upon theſe is leſs quick, and leſs evident, than upon heavy oils.

Secondly. If acetous acid (diſtilled vinegar) be placed within the atmoſphere of oxygenated mu-

riatic

riatic acid gas, it very ſoon acquires a ſmell ſimilar to that of acetic acid, (radical vinegar); it alſo becomes capable of diſſolving copper, and of forming what are called cryſtals of Venus. I have alſo obſerved, that acetous acid, by bing diſtilled with calx of mangaueſe, becomes oxygenated to ſuch a degree that it will diſſolve copper; whereas this acid has not that property when it is not ſuperſaturated with oxygen.

Thirdly. Copper, when expoſed to the vapour of oxygenated muriatic acid, is calcined and covered with a coat of ruſt, which may be eaſily ſeparated from it by the ſlighteſt agitation; this calx of copper may be diſſolved in acetous acid, and form cryſtals of Venus. It may be uſed in all caſes where verdegris is employed; its colour is rather more green than that of common verdegris, but, when this latter is perfectly dried, their colours become more like each other, and indeed differ very little.

END OF VOL. I.

INDEX

TO THE

FIRST VOLUME.

A

Page

ACID, *acetous*, Effect of oxygenated muriatic acid on it, 431
——— *muriatic*, *oxygenated*. Method of bleaching with it, - - 53. 121. 190. 260
——————————— Observations on, 355. 427
Air, *hot*. Patent for warming rooms with it, - 21
Anderson, *James*, *LL.D.* Method of curing butter practised at Udny, - - 389
Antis, *Mr. John*. Improvement of the common spinning-wheel, - - - 37
Ashton, *Mr. Samuel*. Patent for a new method of tanning, 4

B

Banks, *Sir Joseph*. Method of curing the scab in sheep, 97
Barilla, *British*, patent for making, - - 89
Bayley, *Mr. James*. Patent for dying handkerchiefs, &c. 225
——————— Description of a proportional scale, 244
Bell, *Mr. William*. Patent for new invented buckles, 149
Bellamy, *Mr. John*. Patent for making leather, &c. water-proof, - - - - - 73

Page

Berthollet, M. Account of the method of bleaching cloths, &c. - - 53. 121. 190. 260

Bleaching cloths, thread, &c. - 53. 121. 190. 260. 427.

——— paper, prints, &c. - - 356

Block. Deſcription of a ſpring one, - - 44

Bolt-drawer, deſcription of, - - 246

Books. Method of bleaching them, - - 357

Bramah, Mr. Joſeph. Patent for a new conſtructed water-cock, - - - 361

Buckles, patent for, - - - 149

Bucknall, Thomas Skip Dyot, Eſq. Obſervations on pruning orchards, - - - 25

Butter, obſervations on making, - - 234

——— to deprive of the taſte of turnips, - 308

——— method of curing, at Udny, - - 389

——— on ſalting, in ſtone jars, - - 391

C

Campbell, Mr. Hector. Patent for deſtroying colour in rags, &c. - - - 156

Canal-lockage. On ſaving a portion of the water commonly expended in it, - - 376

Canals, navigable, patent for, without locks, - 81

Caoutchouc, method of making inſtruments with it, 70

Carriages, experiments on, - - 101

Cartwright, The Rev. Edmund. Deſcription of a patent machine for combing wool, - - 228

Caſt iron, patent for making, - - 370

Chaptal, M. Obſervations on oxygenated muriatic acid, 355. 427

Cheeſe, Stilton, method of making, - - 175

Chimneys, mode of extinguiſhing fire in them, - 295

——— *ſmoky,* apparatus to prevent, - 289

Chineſe. Their method of making large ſheets of paper, 41

Cock. Patent for one, - - 361

Colour,

Page
Colour, patent for deftroying, - - 156
Compaffes, *fea*, remarks on, - - - - 112
Conductors, improvement on, - - 114
Copper. Effect of oxygenated muriatic acid on it, 432
Cows. On keeping them in the houfe, - 241. 306
Cranes, [illegible]rivance to prevent accidents in, - 35

D

D'Atlen, *Baron*. On keeping milch cows in the houfe, 241
Diftances, inftrument for meafuring, - 163
Dixon, *Mr. Jofeph*. Defcription of a prefervative wheel, &c. 34
Drury, *Capt. Obrien*. Obfervations on the magnetic fluid, 111
Dundonald, *Earl of*. Patent for extracting tar, &c. from pit coal, - - - 145

E

Edgeworth, *Richard Lovell*, *Efq*. Experiments on wheel carriages, - - - 101
Elaftic gum. Method of making inftruments with it, 70. 131

F

Fire in chimneys, mode of extinguifhing, - 295
Fire-engines. Patent for leffening the confumption of fuel in them, - - - 217
Franklin, *Dr*. Defcription of the Chinefe manner of making large fheets of paper, - - 41
Fullarton, *William*, *Efq*. Patent for making malleable iron, 297

G

Glauber's falt, patent for making, - - 303
Gower, *Charles*, *M. A*. Patent for depurating animal oil, 221
Groffart, *M*. Method of making inftruments of elaftic gum, - - - 70. 131

H

Page
Handkerchiefs, &c. patent for dying, - 225
Hats. Patent for making, - - - 1
Heat, patents for communicating it to rooms, &c. 21. 300
Henry, Mr. Thomas. On preserving sea water from putrefaction, - - - 178
Hippobosca ovina, method of destroying, - 99
Hopkinson, Francis, Esq. Description of a spring-block, 44
——— Description of a machine for measuring a ship's way, - - 49
Hoyle, Mr. John. Patent for communicating heat to buildings, - - - 300
Hughes, Mr. Hugh. Description of a machine for twitching wool, - - - 93

I

Inflammable vapour force, patent for, - 154
Ink, used in copying writings, - - 18
Iron, cast, patent for making, - - 370
—— *malleable,* patent for making, - - 297

K

King, Mr. James. Patent for making British barilla, 89
Kitchen-range, patent for, - - 289

L

Leaden-vessels. On keeping milk in them, - 391
Leather. Patent for making it water-proof, - 73
—— On rendering it impermeable to water, 202. 274. 341. 409
—— On the art of currying it, - - 347
Leslie, Mr. Robert. On ascertaining a standard of measure, 170
——— Description of a tide wheel, - 385

Letters,

Page

Letters, patent for copying, - - 13
Lightning-rods, improvement on, - - 114
Lockage. On ſaving part of the water expended in it, 376
Locks. Patent for conſtructing canals without them, 81
Luting-veſſels, compoſition for, - - 312

M

Magnetic fluid, obſervations on, - - 111
Maſſey, James, Eſq. Treatiſe on ſaltpetre, 248. 321. 392
Meaſure, on a method of aſcertaining a ſtandard of, 170
Meaſuring a ſhip's way, machine for, - - 49
——— *diſtances*, inſtrument for, - - 163
Meniſh, Mr. William. Patent for making ſal-ammoniac, &c. 303
Milch Cows. On keeping them in the houſe, 241. 306
Milk. On keeping it in leaden veſſels, - 391
Monk, Mr. John. Method of making Stilton cheeſe, 175
Motion, patent for communicating, by inflammable vaponr force, - - - 154

N

Nail-drawer, deſcription of, - - 246
Navigable canals, without locks, patent for, - 81
Needles, for ſea compaſſes, remarks on, - 112

O

Oil, animal. Patent for depurating it, - 22
Oils. Effect of oxygenated muriatic acid on them, 4 1
Orchards. On pruning them, - - 5
Oxygenated muriatic acid. Method of bleaching with it, 53. 121. 190. 260. 427
——— Obſervations on it, - 355. 427

P *Paper.*

P

Page

Paper. Chinese method of making large sheets, - 41
——-- Method of bleaching it, - - - 356
Patterson, Robert. Improvements on conductors, or lightning rods, - - - 114
Peacock, James, Esq. Idea of an instrument for measuring distances, - - - 163
——————— Description of three instruments for drawing in perspective, - - 313
Perspective, instruments for drawing in, - - 313
Pickering, Exuperius. Patent for constructing navigable canals without locks, - - 81
Pit coal, patent for extracting tar, &c. from, - 145
Pitt, William, Esq. On saving a proportion of the water commonly expended in canal-lockage, 376
Pot-ash. On its use in making saltpetre, - 401
Preservative Wheels, for cranes, description of, - 34
Presses, description of, used in copying writings, - 18
Prints. Manner of bleaching them, - 357. 360
Proportional scale, description of, - - 244
Pruning, observations on, - - - 25
Putrefaction, on preserving sea-water from, - 178

R

Rags. Patent for destroying their colour, - 156
——- Method of bleaching them, - - 156
Rennie, Broun, and Shirreff, Messrs. Observations on keeping milch cows in the house, - 306
Retorts, stone. Method of preventing them from breaking, 310
Rich, Mr. William. Description of a nail and bolt drawer, 246
Robertson, George. On making butter, and on keeping milch cows in the house, - - 234

Robinson,

Page

Robinson, Ebenezer. Method of dissipating noxious vapour in wells, &c. - - - 119

Rowland, Edward. Patent for constructing navigable canals without locks, - - 81

S

Saint Real, Chevalier de. On rendering leather impermeable to water, - 202. 274. 341. 409

Sal-ammoniac, patent for making, - - 303

Saltpetre, treatise on, - - 248. 321. 392

Scab in sheep, method of curing, - - 97

Scale, proportional, description of, - - - 244

Sea water. On preserving it from putrefaction, 178

Sheep. Method of curing their disorder called the scab, 97

Sheep-fagg, method of destroying, - - 99

Ship's way, machine for measuring, - 49

Shoe-fastening, patent for, - - - 149

Smoke. Patent for changing it into useful materials, 373

Smoky chimneys, apparatus to prevent, - 289

Spinning-wheel, improvement of, - - 37

Spring-block, description of, - - 44

Standard of measure, on ascertaining, - 170

Steam-engine, patent for, - - 217

Stilton cheese, method of making, - - 175

Stone jars. On salting butter in them, - - 391

Stove. Patent for one, - - - 289

Stratton, Mr. George. Patent for an improved kitchen-range, 289

Street, Mr. Robert. Patent for producing an inflammable vapour force, &c. - - - 154

T

Tanning, patent for a new method of, - 4

——— remarks on, - - 205. 278. 343

Tar, patent for extracting, from pit coal, - 145

Page

Tar, medicated, compoſition of, - - 32
Telegraph, deſcription of, - - - 382
Tide-wheel, deſcription of, - - 385
Tilſon, Mr. Joſeph. Patent for making hats, - 1
Twitching wool, machine for, - - 93

V

Vapour. Patent for c..nging it into uſeful materials, 373
——— *noxious*, method of diſſipating, - 119
Vinegar. Effect of oxygenated muriatic acid on it, 431

W

Ward, Mr. Charles William. Patent for changing ſmoke or vapour into uſeful materials, - 373
Warming rooms, &c. patents for, - - 21. 300
Water-cock, patent for, - - - 361
Water-proof leather, patent for, - - 73
————— on making, - 202. 274. 341. 409
Watt, Mr. James. Patent for copying writings, - 13
————— Patent for leſſening the conſumption of ſteam and fuel in fire-engines, - 217
Wells. Method of diſſipating noxious vapour in them, 119
Wheel. Deſcription of one to be turned by the tide, 385
Wheel-carriages, experiments on, - - 101
Wheel-crane, improvement of, - - 34
Wilkinſon, Mr. John. Patent for a new method of making caſt iron, &c. - - - 370
Willis, Mr. Thomas. Method of preventing ſtone retorts from breaking, &c. - - 310
Wool, machine for twitching, - - - 93
——- patent machine for combing, - - 228
Writings, patent for copying, - - - 13

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